

4.0 TRACE ORGANIC CONTAMINANT CONCENTRATIONS

This section describes the results of the trace organic analyses for aquatic organisms from Galveston Bay. All of the data in this report are on a dry weight basis unless specifically stated to be on a wet weight basis. The historical data available regarding contaminant concentrations in fish and shellfish from Galveston Bay is limited. However data from the NOAA NS&T Program (Wade *et al.*, 1988, Sericano *et al.*, 1990a,b) suggested that the contaminant concentrations were in the low parts per billion range. Past programs have measured semi-volatile priority pollutants only, and the less sensitive methods rarely detect any contaminants. The analytical program was therefore devised to measure specific analytes (i.e., DDT, PCB, PAH) at trace concentrations (ng/g), and to screen only selected samples for the entire suite of semi-volatile EPA priority pollutants (PP) using less sensitive methods. This screening did not detect any EPA PP.

Organic contaminant concentrations were determined in oysters, crabs, edible fish tissue and composite fish livers (see Section 3 for details). The analytical methods used (Appendix D) were those used for the NOAA's National Status and Trends (NS&T) Program and EPA's Environmental Monitoring and Assessment Program (EMAP). These methods have been verified by intercalibration exercises overseen by NOAA/NIST. The data produced by this study can therefore be compared to the large database available from the NOAA NS&T Program and assures the data is of the highest quality. A summary of the data is provided in Table 4.1. Figures 4.1 to 4.18 show the organism concentration (ppb) dry weight for selected analytes or sum of analytes as bar graphs. Lines are drawn to show the average concentration for fish, fish livers and the overall site average for all analytes.

4.1 Polycyclic Aromatic Hydrocarbons

A total of 24 individual PAHs were quantitated and the sum of 18 are reported here (Wade *et al.*, 1988). The total PAHs reported here include all of the 16 EPA priority pollutant PAHs. Also reported are the sum of the alkylated PAHs. PAHs can originate from two major sources, petroleum and the combustion of organic matter (including fossil fuels). The presence of alkylated PAHs are generally indicative of a petroleum source. Total PAHs concentrations ranged from nondetectable (~20 ng/g) to 1253 ng/g. The distribution between sample type (oysters, crabs, fish and fish livers) and the four collection sites is shown in Figures 4.1 and 4.2. Oysters had higher total PAHs concentrations than crabs at all the sites except GBHR, where the concentrations were nearly the same. Oysters had higher average total PAHs concentrations than fish at all the sites. Oysters had higher average total PAHs concentrations than fish livers at GBMP and GBCR, comparable concentrations at GDEP, and lower at GBHR. These results are not surprising. Fish and crabs have a much higher efficiency for metabolizing PAHs than oysters. The metabolism in fish takes place mainly in the liver and therefore the concentrations in fish livers can be higher. It is interesting to note, however, that the metabolite may be more harmful than the original PAH. It is also important to realize that oysters are sedentary and reflect the average condition of the environment over the past month or so where they

were collected. Crabs and fish, on the other hand, are mobile and reflect the contaminant loading integrated over both time and space.

The alkylated PAHs provide an indicator of the input of PAHs from petroleum. The alkylated PAHs (Figures 4.3 and 4.4) were low at all sites when compared to the total PAHs except at Eagle Point. The absence of the alkylated PAHs indicates that the main input source of the PAHs is from combustion sources, and not petroleum. However, this is not the case at Eagle Point. Due to the Apex Barge spill there is elevated concentration of alkylated PAHs in fish livers and even some fish tissues. Follow-up studies by GERG indicate that these levels are decreasing (Brooks *et al.*, 1991). The livers of some fish do contain relatively high concentrations of alkylated PAHs, indicative of petroleum. Oysters from Morgans Point in the upper bay and Carancahua Reef in the lower bay have similar average total PAHs concentrations (802 and 642 ng/g, respectively). However, the oysters from Morgans Point contain no alkylated PAHs, indicating little or no input from petroleum, while the oysters from Carancahua Reef contain alkylated PAHs.

The distribution of the relative abundances of high and low molecular weight PAHs was different for crabs, fish and fish livers, compared to oysters (Figures 4.5-4.8). All of the crabs, fish and fish liver samples contained over 80% low molecular weight (LMW) PAHs and under 20% high molecular weight (HMW) PAHs, except at Eagle Point, where some fish tissue samples contained as much as 58% HMW PAH. This is most likely due to the impact of the Apex Barge spill. The oysters contain predominantly more of the HMW PAHs than the crabs, fish or fish livers. This is most likely related to the ability of crabs and fish to metabolize HMW PAHs faster than LMW PAHs and to metabolize all PAHs much faster than oysters. While PAHs were detected at all sampling sites in all sample types, the concentrations found are not extremely high, even in the samples from Eagle Point that were collected near the Apex Barge Oil spill.

4.2 Pesticides and PCBs

A suite of chlorinated hydrocarbons and PCBs were analyzed. The concentration of the individual compounds, including 20 PCB congeners, are reported in Appendix A. A summary of the concentrations of selected pesticides or classes of pesticides, including total BHCs, total Chlordane, Dieldrin, total DDTs, and total PCBs are given in Table 4.1. The results from other pesticides measured are reported in Appendix A.

The concentrations of total BHC were generally higher in oysters when compared to crabs and fish tissue, but lower than fish livers (Figures 4.9 and 4.10). The concentration in fish livers was quite variable, with flounder generally having higher concentrations. BHC average concentrations was highest (8.85 ng/g) at Morgans Point and similar at Eagle Point, Hanna Reef and Carancahua Reef with average site concentrations of 5.08, 3.66 and 4.27 ng/g, respectively.

The average site concentration for total chlordanes was highest at Morgans Point (58 ng/g) and it decreased down Bay. The concentration of total chlordanes in

oysters, crabs and fish are similar at all sites, while fish livers have higher concentrations (Figure 4.11 and 4.12). The livers in some cases (i.e., jackfish from Eagle Point) had total chlordane an order of magnitude higher than the oysters, crabs or fish tissue. This is probably due to transport and accumulation of these lipoidal compounds in the liver.

Total DDTs is defined as the sum of DDT and its breakdown products DDD and DDE. Total DDT (Figures 4.13 and 4.14) has a similar pattern to the other chlorinated hydrocarbons, with higher concentrations at Morgans Point and decreasing concentrations down Bay. As was the case for the other chlorinated pesticides, the concentrations of oyster, crabs and fish tissue are similar at each site and the liver concentrations are generally higher. However, some fish with higher than average tissue levels (i.e., hardhead catfish from Eagle Point) have higher concentrations than the composite liver sample from these same fish (Figure 4.13).

Dieldrin (Figures 4.15 and 4.16) shows no distinctive down Bay trend. The site average concentrations are similar from Morgans Point, Eagle Point, Hanna Reef and only slight lower at Carancahua Reef. As with the other pesticides, dieldrin concentrations are generally higher in fish livers, similar in fish and oysters, and slightly lower in crabs.

Total PCB concentrations show the typical down Bay trend of higher concentrations at Morgans Point, lower concentrations at Eagle Point and lowest concentrations at Hanna Reef and Carancahua Reef. The average total PCB concentration is similar in oysters and fish tissue and slightly lower in crabs. The liver PCB concentrations are the highest of any of the samples analyzed. As discussed earlier, this is likely due to the high lipid concentrations in the liver compared to the other tissue samples.

4.3 Overview

The concentrations of PAH, total BHCs, total chlordane, dieldrin, total DDTs and total PCBs found in oysters, crabs, fish and fish livers provided no surprises. These concentrations are within the range of concentrations reported from oysters for Galveston Bay as part of NOAA National Status and Trends Program. The concentrations are also not extreme, in the sense that analysis did not detect any real "hot spots". The general trend of decreasing contaminant loading down bay was also expected because most of the chronic contamination measured comes from areas of highest population and industrial activity in the upper bay. The impact of PAHs from petroleum spills is an exception to this general trend. It is hard to compare contaminant concentrations in the various fish species because of possible different life histories and the fact that fish are mobile and their body burdens reflect the average contamination of their whole spatial range. This is also true for crabs. One advantage of oysters as biomonitors is that they are sedentary and therefore reflect a small spatial area. The similarity between oysters, fish and crabs at these sites, therefore, indicates a consistent contamination loading over a fairly large area. Livers were found, in general, to have higher contaminant concentrations, due to their high lipid content. The

ect of these contaminants on liver functions is not known. Oyster contaminant concentrations showed no significant correlation to lipid content for NS&T Gulf of Mexico oysters (Wade et al. 1988). But, gonadal material of oysters has higher contaminant concentration than body tissue (Wade, personal communication).

In conclusion, the contaminant concentrations found were within the expected range based on NOAA NS&T data for Galveston Bay. The concentrations are near the median for the entire Gulf of Mexico. Higher concentrations are found in the upper bay and concentrations decreased in the lower bay. These trends are consistent with chronic inputs.

SITE		PAHs											
Tissue Type Fish Type	n	Σ PAH (S&T) (ppb)			Σ PAH (Alkylated) (ppb)			LMW (2-3 Rings) (%)			HMW (4-5 Rings) (%)		
		Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
Morgans Point (MP)	67	181	0	1253	2	0	73	83	12	100	17	0	88
Blue Crab	11	59	26	175	0	0	0	83	36	100	17	0	64
Virginia Oyster	12	802	398	1253	0	0	0	34	12	77	66	23	88
Fish Tissue	30	18	0	53	2	0	26	98	72	100	2	0	28
Blackdrum	6	12	0	22	0	0	0	98	89	100	2	0	11
Hardhead Catfish	11	26	13	53	5	0	26	97	81	100	3	0	19
Reddrum	8	16	10	26	0	0	0	100	100	100	0	0	0
Southern Flounder	3	10	0	16	0	0	0	100	100	100	0	0	0
Striped Mullet	2	16	14	19	0	0	0	86	72	100	14	0	28
Fish Liver	14	93	0	283	5	0	73	95	76	100	5	0	24
Blackdrum	3	63	0	98	0	0	0	88	76	100	12	0	24
Hardhead Catfish	5	32	0	87	0	0	0	100	100	100	0	0	0
Reddrum	4	118	82	117	0	0	0	96	83	100	4	0	17
Southern Flounder	1	283	283	283	73	73	73	87	87	87	13	13	13
Striped Mullet	1	203	203	203	0	0	0	92	92	92	8	8	8
Eagle Point (EP)	64	72	0	309	90	0	2311	85	0	100	12	0	78
Blue Crab	10	61	23	165	2	0	22	96	83	100	4	0	17
Virginia Oyster	12	123	27	244	0	0	0	63	22	100	37	0	78
Fish Tissue	30	37	0	85	39	0	655	90	38	100	10	0	62
Blackdrum	8	41	15	78	12	0	59	97	85	100	3	0	15
Creville Jack	1	85	85	85	655	655	655	81	81	81	19	19	19
Flounder	1	43	43	43	0	0	0	43	43	43	57	57	57
Hardhead Catfish	3	36	21	64	51	37	68	99	97	100	1	0	3
Reddrum	3	50	22	73	35	0	104	75	38	100	25	0	62
Sheepshead	3	34	26	45	4	0	12	79	45	100	21	0	55
Southern Flounder	5	25	13	55	6	0	30	97	87	100	3	0	13
Spotted Seatrout	6	27	0	39	19	0	115	94	88	100	6	0	12
Fish Liver	12	117	0	309	380	0	2311	83	0	100	1	0	10
Blackdrum	3	152	69	309	89	0	200	100	100	100	0	0	0
Creville Jack	1	192	192	192	2311	2311	2311	90	90	90	10	10	10
Flounder	2	173	144	201	366	85	646	100	100	100	0	0	0
Hardhead Catfish	1	0	0	0	0	0	0	0	0	0	0	0	0
Reddrum	1	113	113	113	867	867	867	100	100	100	0	0	0
Sheepshead	1	58	58	58	58	58	58	100	100	100	0	0	0
Spotted Seatrout	3	78	0	183	107	45	183	67	0	100	0	0	0

Table 4.1 Summary of GBNEP PAH, Pesticide, and PCB Concentrations (dry weight)

SITE		PAHs											
Tissue Type Fish Type	n	Σ PAH (S&T) (ppb)			Σ PAH (Alkylated) (ppb)			LMW (2-3 Rings) (%)			HMW (4-5 Rings) (%)		
		Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
Hanna Reef (HR)	66	85	0	559	44	0	869	86	0	100	14	0	100
Blue Crab	11	76	18	312	0	0	0	90	72	100	10	0	28
Virginia Oyster	12	57	0	195	2	0	25	50	0	100	50	0	100
Fish Tissue	30	34	10	182	21	0	324	96	76	100	4	0	24
Atlantic Croaker	2	84	84	85	43	43	43	99	97	100	1	0	3
Blackdrum	4	17	12	21	0	0	0	100	100	100	0	0	0
Flounder	2	15	15	16	0	0	0	100	100	100	0	0	0
Reddrum	4	55	12	182	81	0	324	100	100	100	0	0	0
Southern Flounder	8	14	10	22	0	0	0	93	76	100	7	0	24
Spotted Seatrout	10	42	13	101	22	0	129	95	78	100	5	0	22
Fish Liver	13	234	50	559	175	0	869	92	34	100	8	0	66
Atlantic Croaker	1	80	80	80	0	0	0	100	100	100	0	0	0
Blackdrum	2	176	157	195	0	0	0	100	100	100	0	0	0
Flounder	5	427	328	559	345	98	869	95	89	100	5	0	11
Reddrum	2	150	120	181	0	0	0	93	87	100	7	0	13
Spotted Seatrout	3	60	50	65	182	0	330	78	34	100	22	0	66
Carancahua Reef (CR)	59	209	0	1614	43	0	424	78	0	100	17	0	69
Blue Crab	6	251	79	525	59	0	193	80	59	89	20	11	41
Virginia Oyster	12	642	286	1614	26	0	98	41	32	62	59	38	69
Fish Tissue	27	24	0	44	0	0	0	96	68	100	4	0	32
Blackdrum	4	24	14	31	0	0	0	100	100	100	0	0	0
Gaftopsail Catfish	1	25	25	25	0	0	0	87	87	87	13	13	13
Hardhead Catfish	3	27	19	38	0	0	0	90	71	100	10	0	29
Reddrum	7	25	13	44	0	0	0	99	94	100	1	0	6
Shark	1	42	42	42	0	0	0	100	100	100	0	0	0
Sheepshead	1	24	24	24	0	0	0	83	83	83	17	17	17
Southern Flounder	10	20	0	37	0	0	0	95	68	100	5	0	32
Fish Liver	14	175	0	503	134	0	424	76	0	100	2	0	9
Blackdrum	2	170	141	200	126	0	252	100	100	100	0	0	0
Gaftopsail Catfish	1	0	0	0	0	0	0	0	0	0	0	0	0
Hardhead Catfish	1	0	0	0	0	0	0	0	0	0	0	0	0
Reddrum	3	90	0	208	75	0	225	100	100	100	0	0	0
Shark	1	158	158	158	399	399	399	92	92	92	8	8	8
Sheepshead	1	0	0	0	0	0	0	0	0	0	0	0	0
Southern Flounder	5	337	241	503	201	0	424	95	91	100	5	0	9

Table 4.1 continued

SITE		PESTICIDES														
Tissue Type Fish Type	n	Total BHCs (ppb)			Total Chlordanes (ppb)			Dieldrin (ppb)			Total DDTs (ppb)			Total PCBs (ppb)		
		Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
Morgans Point (MP)	67	8.85	0.00	51.20	57.89	0.71	272.96	7.28	0.00	35.00	86.88	2.35	328.37	611.53	0.00	3979.10
Blue Crab	11	4.32	0.00	7.56	25.76	7.08	45.76	4.48	1.62	7.83	31.83	6.37	64.08	131.65	35.01	191.62
Virginia Oyster	12	13.30	0.00	40.13	96.14	37.49	200.22	16.05	0.00	35.00	147.30	28.47	253.86	545.30	183.94	771.71
Fish Tissue	30	4.02	0.72	13.11	32.01	0.71	171.28	3.91	0.47	15.57	59.57	2.35	305.98	385.61	0.00	2127.40
Blackdrum	6	3.61	0.72	13.11	7.55	0.71	26.12	1.73	0.53	5.11	13.71	2.35	39.28	154.30	17.50	524.60
Hardhead Catfish	11	4.30	2.04	10.10	61.39	22.23	171.28	5.23	3.10	9.19	112.46	37.87	305.98	642.30	192.20	2127.40
Reddrum	8	3.45	0.99	6.36	15.98	4.76	37.26	3.02	1.46	5.63	30.17	12.26	52.80	205.50	0.00	463.50
Southern Flounder	3	5.16	1.91	10.11	9.53	4.52	18.15	1.07	0.47	1.77	13.53	5.97	26.00	229.30	147.00	325.40
Striped Mullet	2	4.24	3.04	5.44	41.71	21.51	61.91	11.01	6.45	15.57	92.97	51.01	134.94	622.60	354.00	891.30
Fish Liver	14	18.96	0.00	51.20	105.82	26.46	272.96	9.17	1.05	33.51	136.86	15.90	328.37	1529.47	417.20	3979.10
Blackdrum	3	13.00	0.00	23.97	40.92	26.46	52.60	5.73	1.74	10.73	57.06	15.90	96.67	793.40	668.70	937.80
Hardhead Catfish	5	8.64	2.40	24.21	80.85	29.09	239.09	4.79	1.05	9.54	97.58	28.98	292.56	1019.10	417.20	2568.30
Reddrum	4	28.14	4.12	51.20	149.55	44.49	267.88	13.95	1.23	33.51	205.67	128.11	312.62	2195.70	1609.40	3081.00
Southern Flounder	1	46.70	46.70	46.70	272.96	272.96	272.96	22.78	22.78	22.78	328.37	328.37	328.37	3979.10	3979.10	3979.10
Striped Mullet	1	23.94	23.94	23.94	83.24	83.24	83.24	8.59	8.59	8.59	105.89	105.89	105.89	1175.00	1175.00	1175.00
Eagle Point (EP)	64	5.08	0.00	162.25	39.72	0.00	409.98	9.25	0.00	60.86	53.73	0.06	329.11	425.40	4.90	2864.70
Blue Crab	10	0.03	0.00	0.27	1.25	0.00	5.38	0.16	0.00	1.56	8.71	2.91	16.45	38.45	12.78	87.30
Virginia Oyster	12	4.79	0.00	14.10	43.25	27.22	60.03	12.66	4.22	23.02	48.00	23.10	89.28	381.67	233.98	556.71
Fish Tissue	30	1.70	0.00	12.17	22.23	0.06	220.42	2.70	0.00	17.63	36.94	0.06	329.11	258.00	4.90	1667.90
Blackdrum	8	1.82	0.00	12.17	4.53	0.72	11.55	1.54	0.00	9.38	5.83	2.73	11.72	144.90	40.00	411.10
Crevalle Jack	1	1.74	1.74	1.74	25.70	25.70	25.70	3.19	3.19	3.19	143.98	143.98	143.98	652.60	652.60	652.60
Flounder	1	0.00	0.00	0.00	2.03	2.03	2.03	1.14	1.14	1.14	5.02	5.02	5.02	124.10	124.10	124.10
Hardhead Catfish	3	6.34	4.42	9.38	148.93	65.68	220.42	13.66	5.74	17.63	242.02	121.67	329.11	1275.10	634.00	1667.90
Reddrum	3	0.42	0.00	1.27	9.25	4.69	16.09	1.69	0.00	4.63	10.99	9.43	12.99	126.70	87.50	186.30
Sheepshead	3	1.11	0.73	1.57	6.02	1.92	8.09	1.57	0.04	4.38	11.22	6.95	16.92	40.50	14.90	61.90
Southern Flounder	5	1.34	0.00	5.91	4.36	1.48	13.02	2.14	0.00	6.71	3.71	2.89	4.82	164.50	19.60	524.90
Spotted Seatrout	6	0.73	0.00	1.42	14.76	0.06	54.76	0.46	0.00	2.69	16.87	0.06	51.15	109.10	4.90	545.90
Fish Liver	12	18.02	0.00	162.25	111.96	18.57	409.98	29.81	4.92	60.86	138.98	35.21	305.84	1210.08	367.90	2864.70
Blackdrum	3	2.39	0.00	5.47	56.78	18.57	122.63	26.34	4.92	60.86	80.23	35.21	128.59	459.40	367.90	613.50
Crevalle Jack	1	0.00	0.00	0.00	409.98	409.98	409.98	26.21	26.21	26.21	305.84	305.84	305.84	2864.70	2864.70	2864.70
Flounder	2	88.90	15.55	162.25	106.27	105.86	106.69	29.29	13.01	45.56	194.66	175.25	214.07	1784.40	1505.80	2062.90
Hardhead Catfish	1	3.19	3.19	3.19	39.76	39.76	39.76	27.37	27.37	27.37	85.60	85.60	85.60	396.10	396.10	396.10
Reddrum	1	1.63	1.63	1.63	117.89	117.89	117.89	5.29	5.29	5.29	72.59	72.59	72.59	982.70	982.70	982.70
Sheepshead	1	9.73	9.73	9.73	38.94	38.94	38.94	51.12	51.12	51.12	44.28	44.28	44.28	454.00	454.00	454.00
Spotted Seatrout	3	5.57	2.13	8.67	118.01	27.80	235.37	36.71	8.80	53.79	176.48	56.32	249.37	1625.50	420.00	2498.10

Table 4.1 continued

SITE		PESTICIDES														
Tissue Type Fish Type	n	Total BHCs (ppb)			Total Chlordanes (ppb)			Dieldrin (ppb)			Total DDTs (ppb)			Total PCBs (ppb)		
		Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
Hanna Reef (HR)	66	3.66	0.00	38.97	10.06	0.00	64.24	10.78	0.00	157.77	26.32	1.55	187.51	175.58	0.00	1120.60
Blue Crab	11	1.66	0.00	9.20	5.52	1.46	14.00	11.93	0.00	57.65	12.72	5.31	23.43	60.67	18.65	160.99
Virginia Oyster	12	5.75	0.00	12.41	9.60	0.00	35.60	3.11	0.00	7.24	17.88	4.75	35.20	164.46	21.90	281.52
Fish Tissue	30	0.66	0.00	3.40	5.53	0.59	26.71	2.44	0.00	22.29	14.02	1.55	51.34	85.91	0.00	198.10
Atlantic Croaker	2	2.78	2.15	3.40	8.33	2.26	14.40	7.95	1.62	14.27	26.81	20.00	33.62	94.30	34.10	154.60
Blackdrum	4	1.13	0.23	2.24	1.47	0.59	2.55	0.11	0.00	0.45	6.04	3.74	8.90	59.70	0.00	183.90
Flounder	2	0.04	0.02	0.07	1.60	0.94	2.25	0.20	0.16	0.23	3.63	1.55	5.72	188.70	179.20	198.10
Reddrum	4	0.17	0.00	0.50	1.19	0.66	1.88	0.21	0.00	0.86	5.07	3.51	8.65	107.10	14.00	146.10
Southern Flounder	8	0.31	0.00	1.32	3.75	0.82	10.27	0.76	0.00	2.46	9.49	3.21	17.84	65.00	0.00	170.00
Spotted Seatrout	10	0.65	0.00	2.71	10.55	2.88	26.71	4.96	0.00	22.29	23.95	6.48	51.34	82.40	0.00	153.90
Fish Liver	13	10.34	0.00	38.97	24.79	4.78	64.24	36.14	0.00	157.77	74.01	18.74	187.51	489.99	131.70	1120.60
Atlantic Croaker	1	12.50	12.50	12.50	12.52	12.52	12.52	4.69	4.69	4.69	18.74	18.74	18.74	312.90	312.90	312.90
Blackdrum	2	2.17	1.83	2.51	6.05	5.04	7.06	39.22	36.68	41.75	21.16	19.31	23.02	140.00	131.70	148.40
Flounder	5	17.52	0.00	38.97	25.60	4.78	40.23	53.23	0.00	157.77	92.39	33.08	123.98	672.80	570.50	893.60
Reddrum	2	4.63	4.21	5.05	17.41	12.94	21.88	47.62	40.52	54.73	53.50	51.28	55.71	261.80	221.20	302.50
Spotted Seatrout	3	6.91	3.07	11.99	44.96	11.50	64.24	8.44	2.60	13.58	110.70	23.79	187.51	629.80	144.60	1120.60
Carancahua Reef (CR)	59	4.27	0.00	41.91	16.05	0.00	297.73	1.95	0.00	18.37	42.05	0.00	1330.30	231.62	0.00	4320.60
Blue Crab	6	1.65	0.00	2.80	5.09	0.97	15.02	1.13	0.00	2.12	5.88	1.83	14.82	109.66	33.68	209.70
Virginia Oyster	12	3.89	1.75	5.67	10.35	1.50	22.60	1.58	0.00	5.83	12.44	4.06	23.72	155.63	66.76	211.38
Fish Tissue	27	0.22	0.00	2.57	2.42	0.26	16.68	1.03	0.00	5.89	6.19	0.00	46.39	55.44	0.00	298.10
Blackdrum	4	0.16	0.00	0.59	1.20	0.77	1.68	1.00	0.00	2.87	3.66	1.93	5.48	31.30	16.50	43.80
Gafronsail Catfish	1	0.00	0.00	0.00	16.68	16.68	16.68	0.95	0.95	0.95	46.39	46.39	46.39	257.60	257.60	257.60
Hardhead Catfish	3	0.03	0.00	0.10	2.68	0.74	5.31	1.02	0.95	1.07	6.18	2.22	9.65	29.70	20.90	45.40
Reddrum	7	0.28	0.00	0.85	2.78	0.26	6.85	2.40	0.00	5.89	5.04	0.00	10.71	37.60	0.00	78.30
Shark	1	0.00	0.00	0.00	2.09	2.09	2.09	0.16	0.16	0.16	11.52	11.52	11.52	26.80	26.80	26.80
Sheepshead	1	0.00	0.00	0.00	1.02	1.02	1.02	0.00	0.00	0.00	1.96	1.96	1.96	298.10	298.10	298.10
Southern Flounder	10	0.33	0.00	2.57	1.32	0.32	3.17	0.29	0.00	1.01	3.87	0.52	9.73	43.70	0.00	111.80
Fish Liver	14	13.54	0.55	41.91	51.93	0.00	297.73	4.39	0.00	18.37	152.08	6.30	1330.30	688.79	37.10	4320.60
Blackdrum	2	1.85	1.20	2.51	15.78	15.46	16.10	3.77	3.32	4.21	28.08	24.74	31.41	342.60	193.70	291.40
Gafronsail Catfish	1	38.55	38.55	38.55	39.02	39.02	39.02	3.57	3.57	3.57	65.82	65.82	65.82	433.80	433.80	433.80
Hardhead Catfish	1	4.84	4.84	4.84	0.00	0.00	0.00	0.00	0.00	0.00	6.30	6.30	6.30	37.10	37.10	37.10
Reddrum	3	4.25	1.41	7.67	30.96	28.40	32.94	4.55	2.98	5.99	65.18	60.82	69.47	401.30	300.50	495.90
Shark	1	2.56	2.56	2.56	297.73	297.73	297.73	18.37	18.37	18.37	1330.30	1330.30	1330.30	4320.60	4320.60	4320.60
Sheepshead	1	14.86	14.86	14.86	9.56	9.56	9.56	0.24	0.24	0.24	16.26	16.26	16.26	230.90	230.90	230.90
Southern Flounder	5	22.45	0.55	41.91	51.24	29.89	69.53	3.63	2.53	5.64	91.76	44.20	136.34	546.30	240.30	763.10

Table 4.1 continued

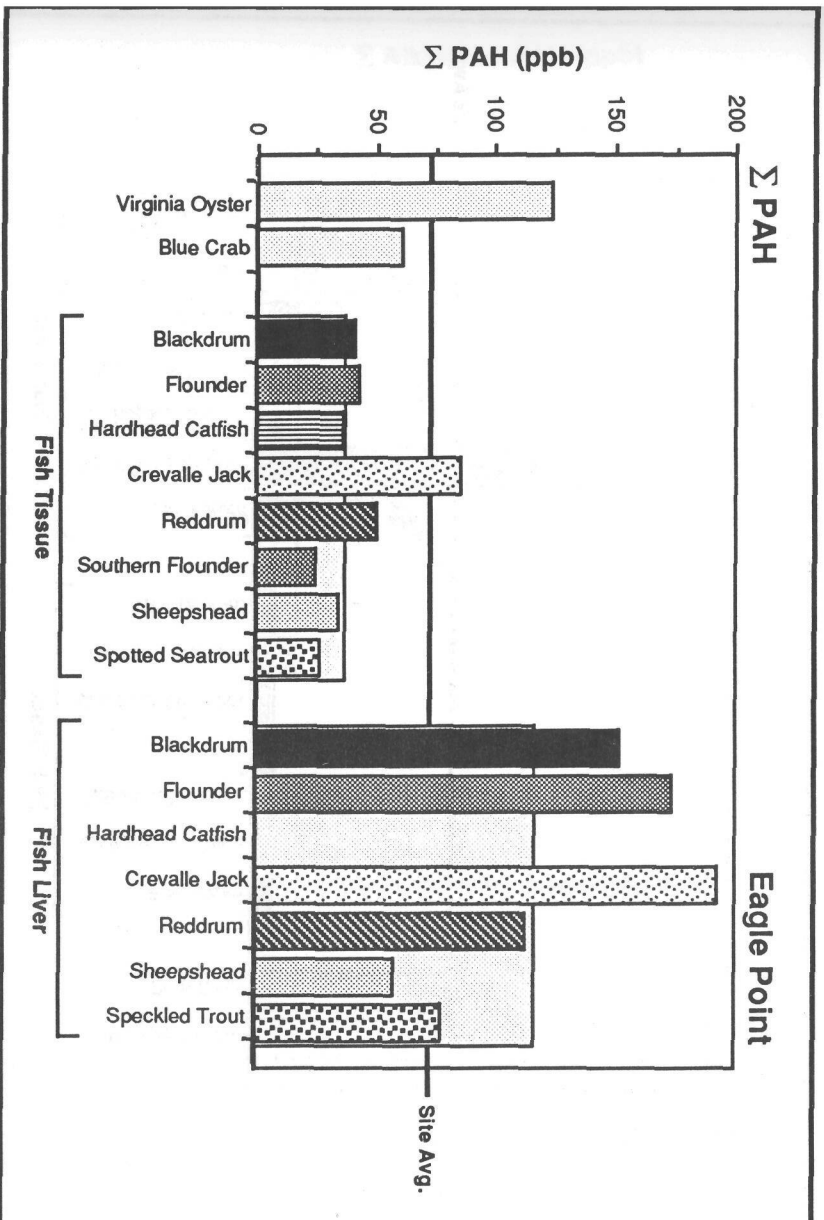
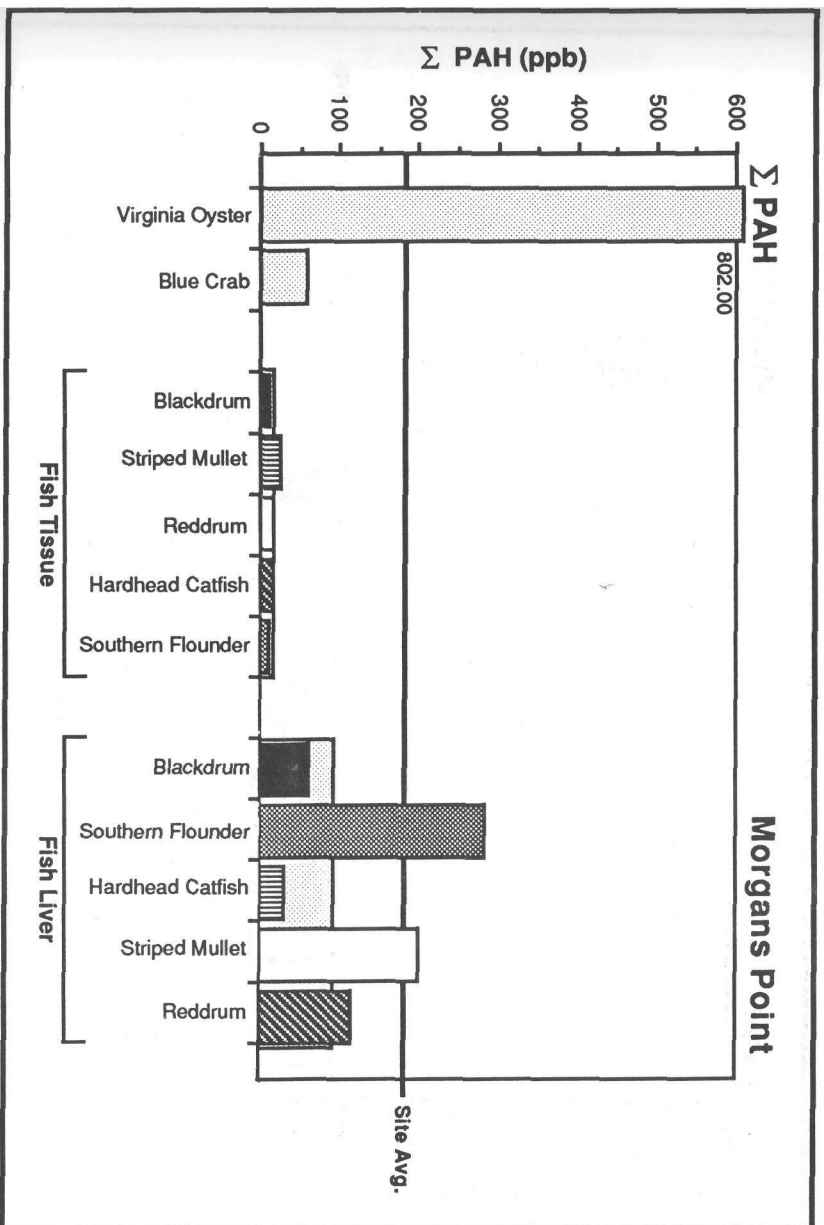


Figure 4.1. Total PAH concentrations (ppb) in oysters, crabs, fish tissue, and fish livers from Morgans Point and Eagle Point.

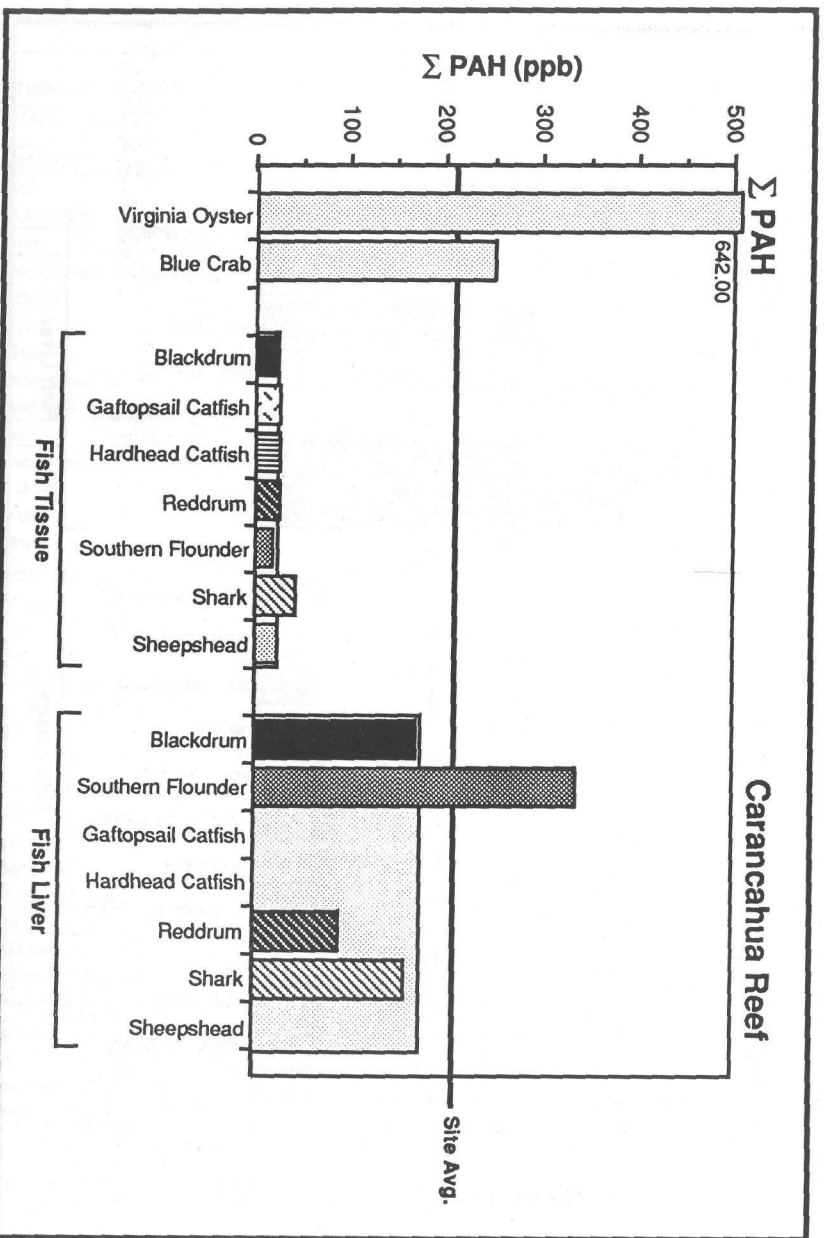
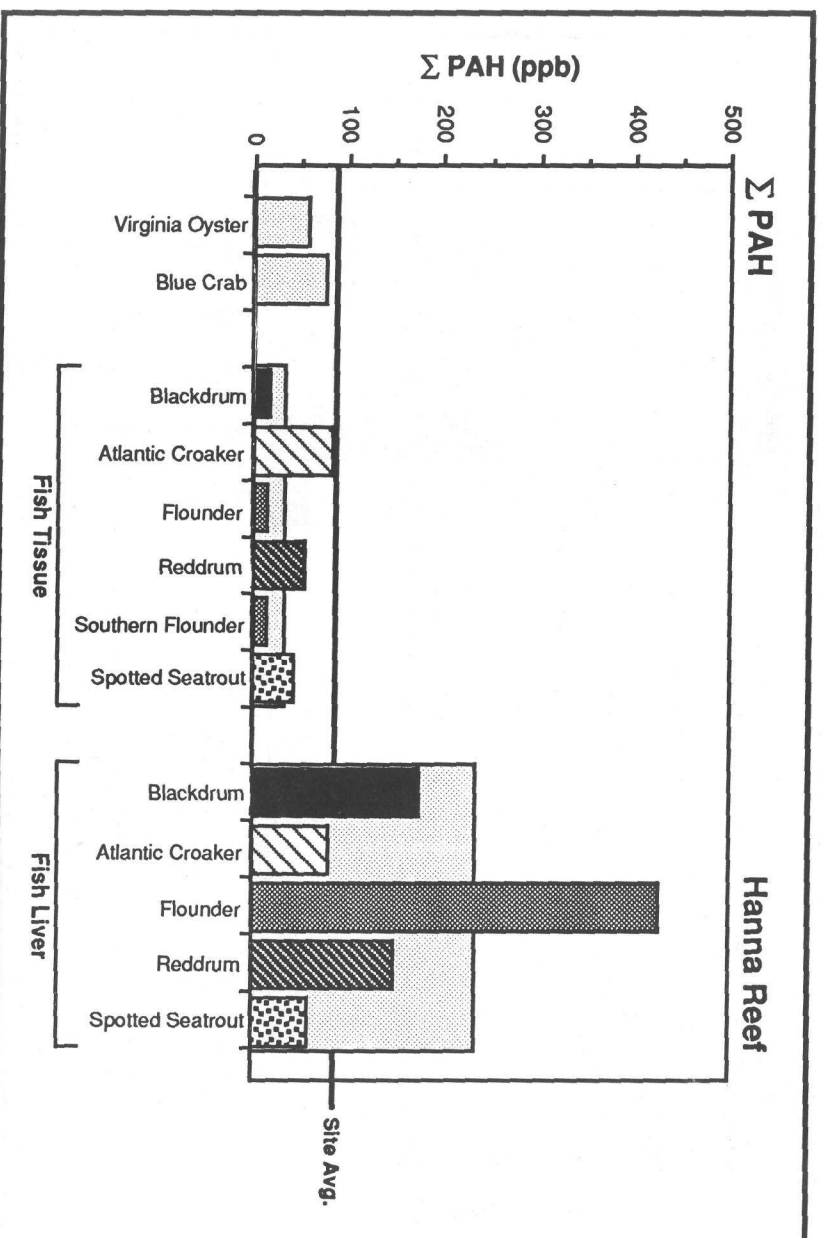


Figure 4.2. Total PAH concentrations (ppb) in oysters, crabs, fish tissue, and fish livers from Hanna Reef and Carancahua Reef.

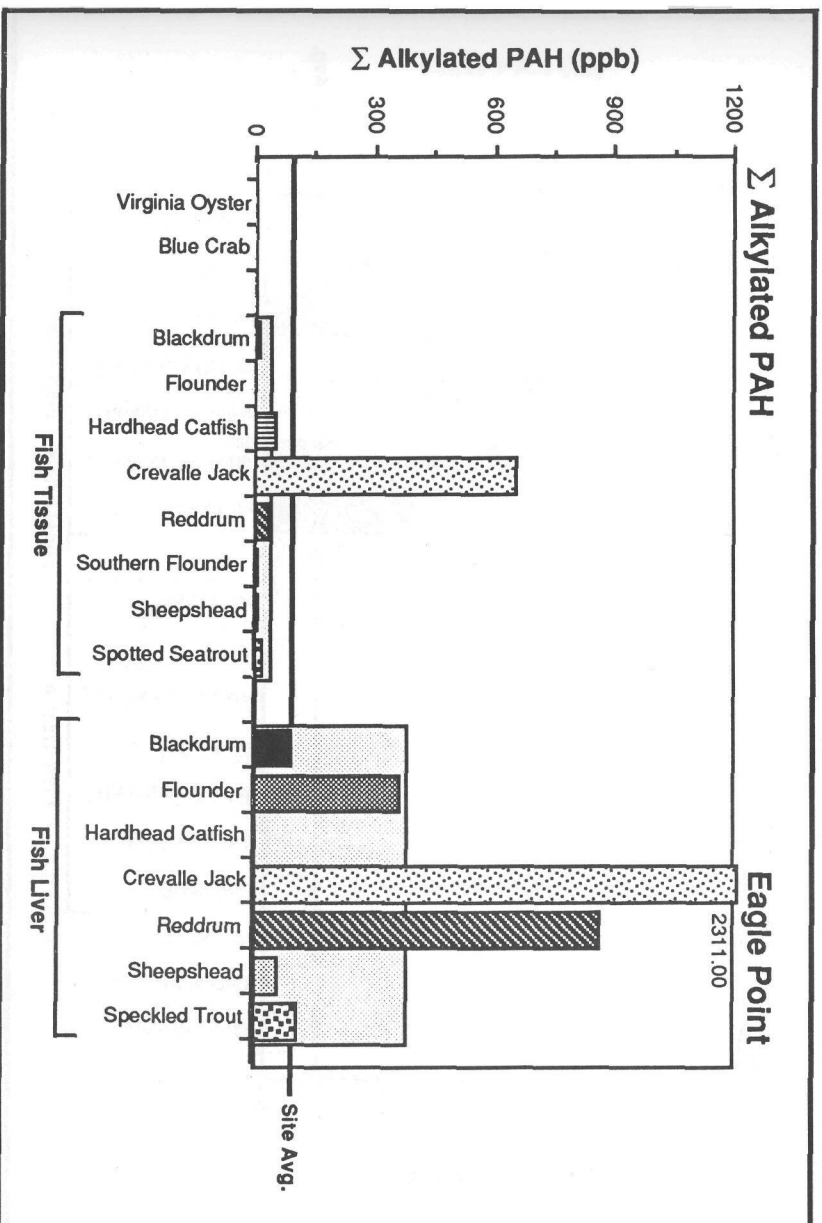
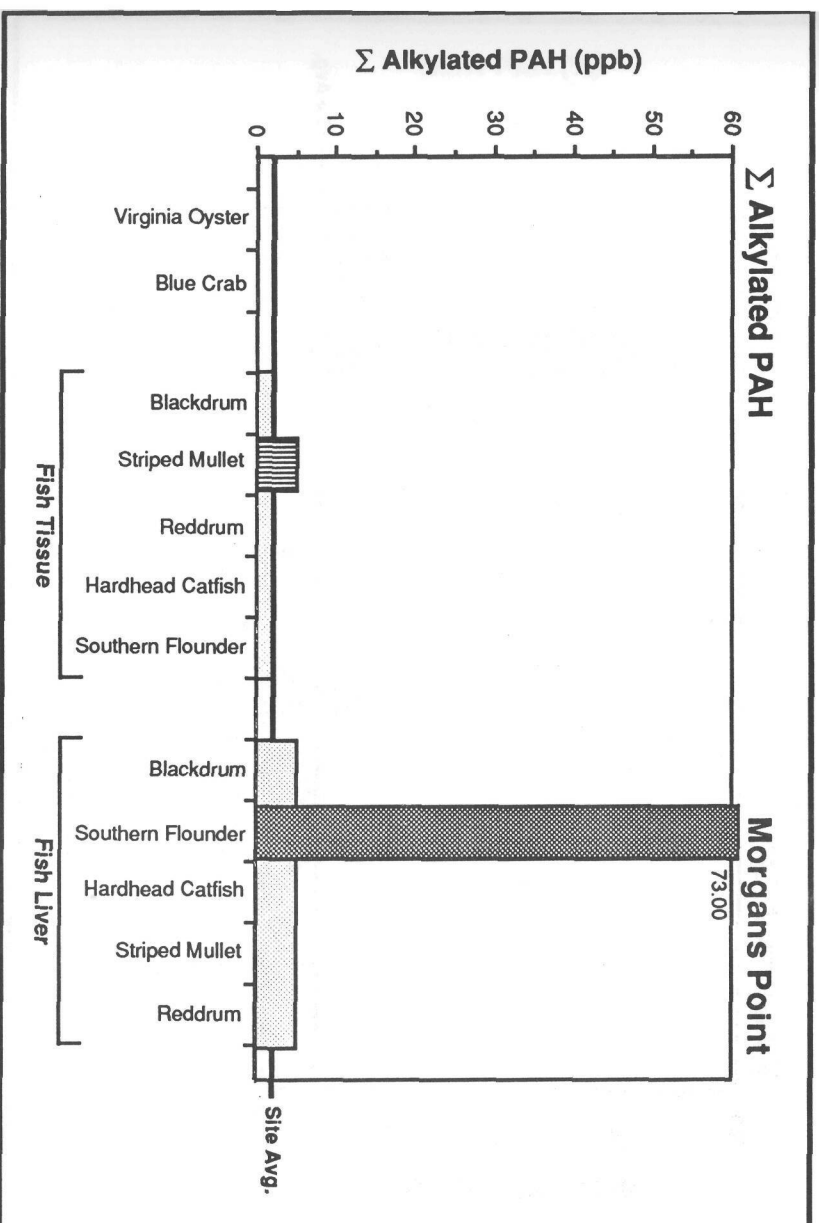


Figure 4.3. Total alkylated PAH concentrations (ppb) in oysters, crabs, fish tissue, and fish livers from Morgans Point and Eagle Point.

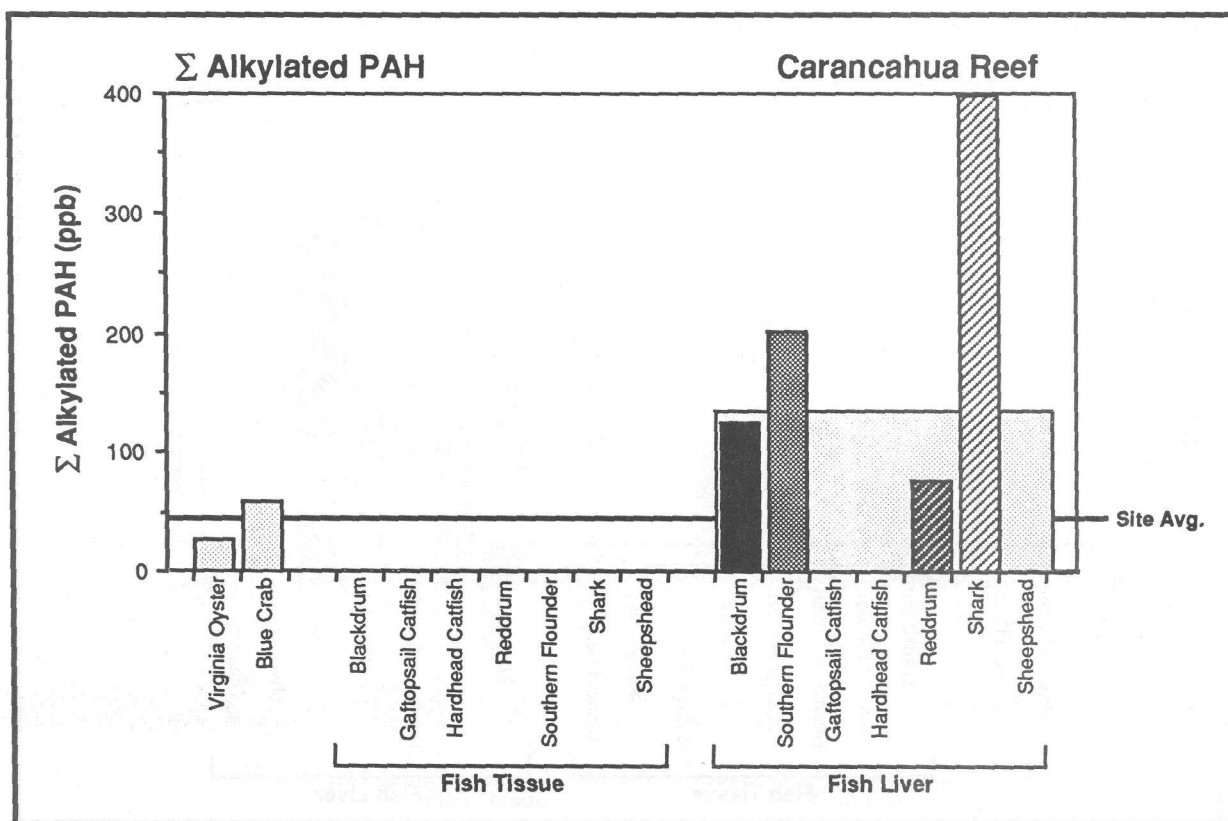
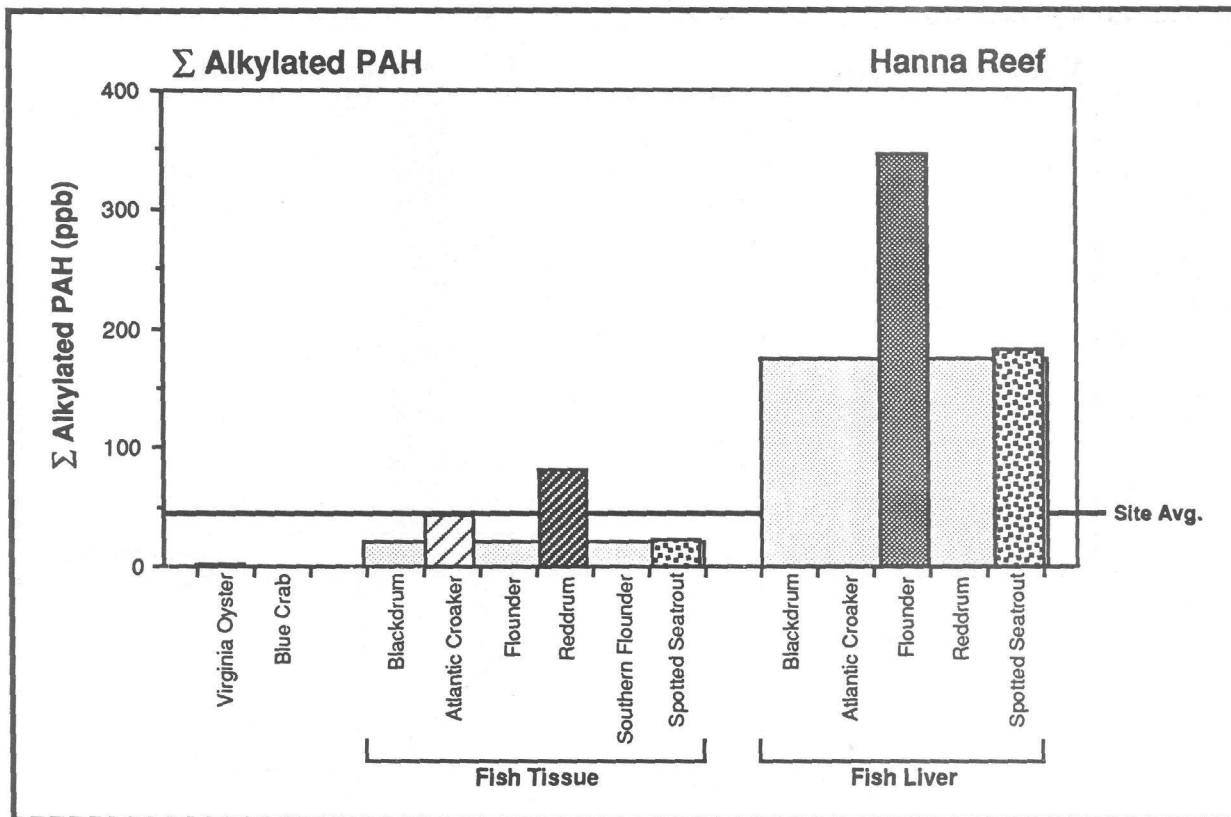


Figure 4.4. Total alkylated PAH concentrations (ppb) in oysters, crabs, fish tissue, and fish livers from Hanna Reef and Carancahua Reef.

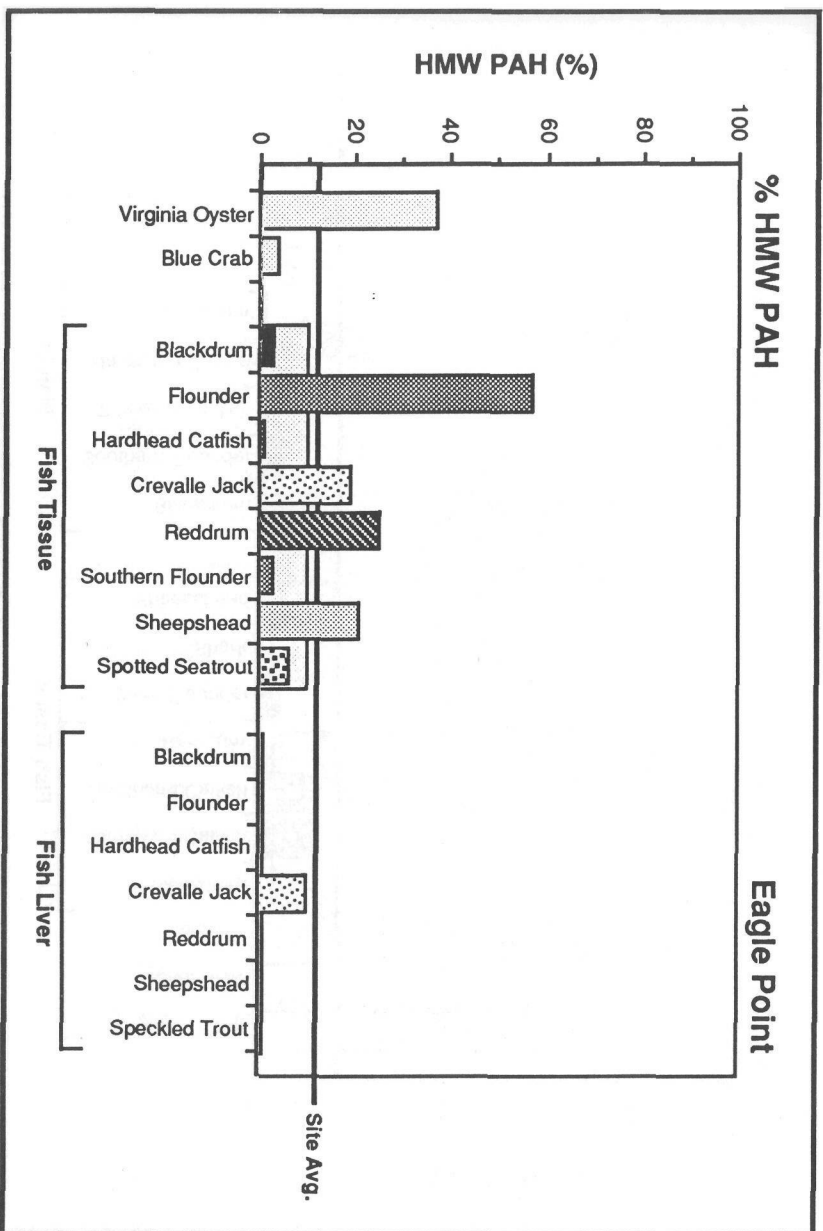
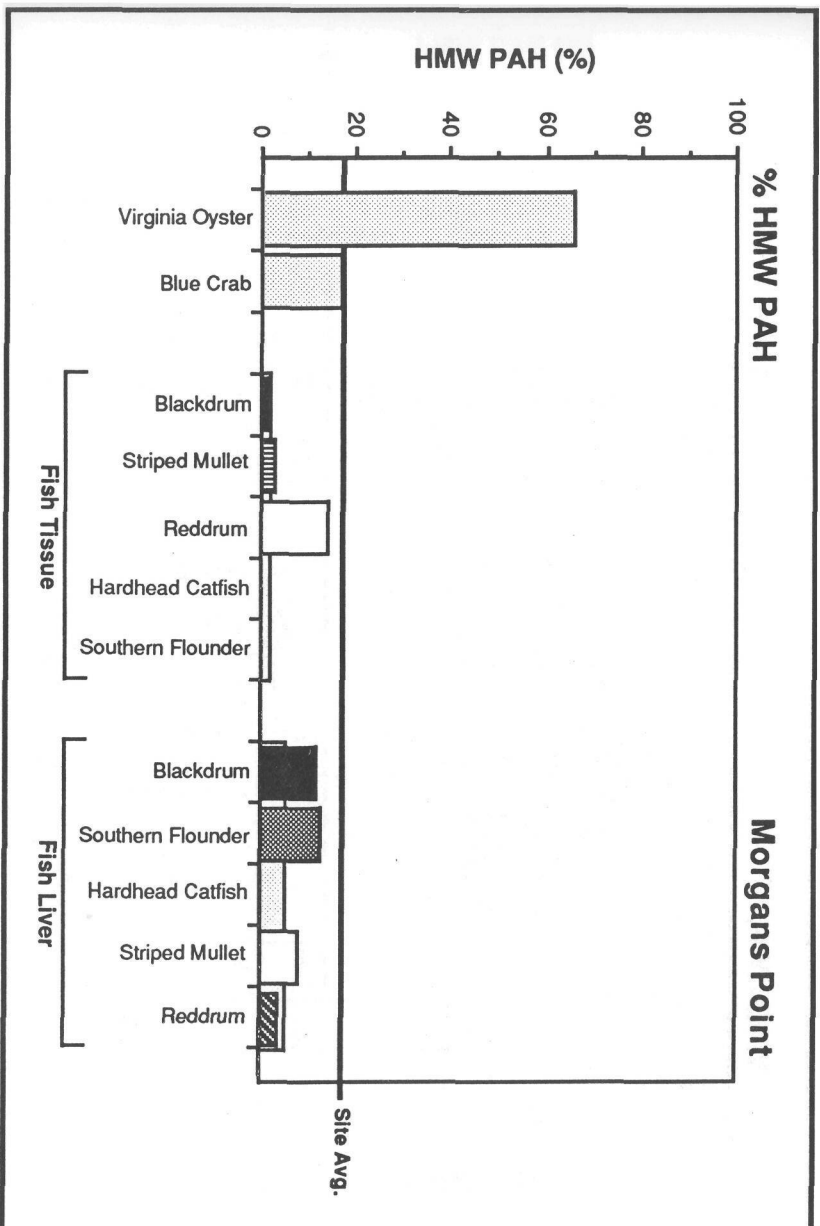


Figure 4.5. Percentage of High Molecular Weight (HMW) PAH in oysters, crabs, fish tissue, and fish livers from Morgans Point and Eagle Point.

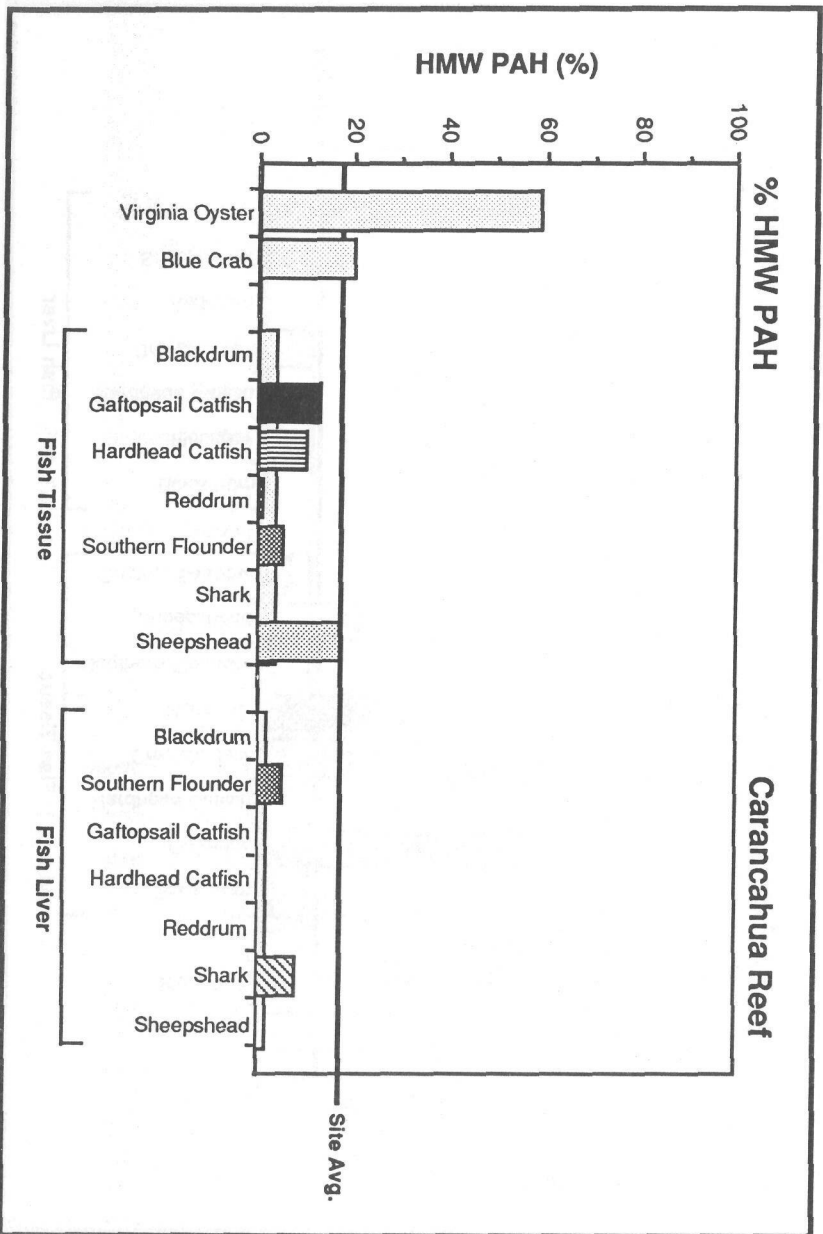
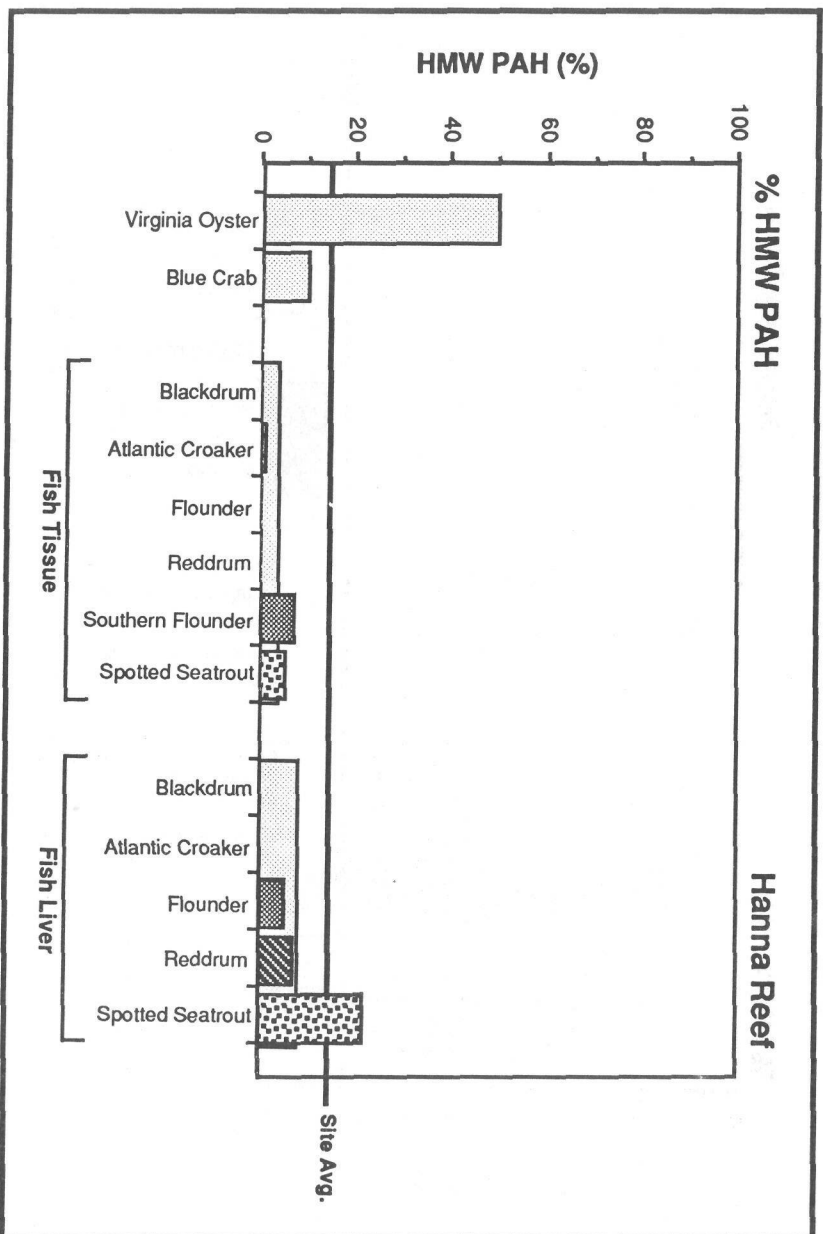


Figure 4.6. Percentage of High Molecular Weight (HMW) PAH in oysters, crabs, fish tissue, and fish livers from Hanna Reef and Carancagua Reef.

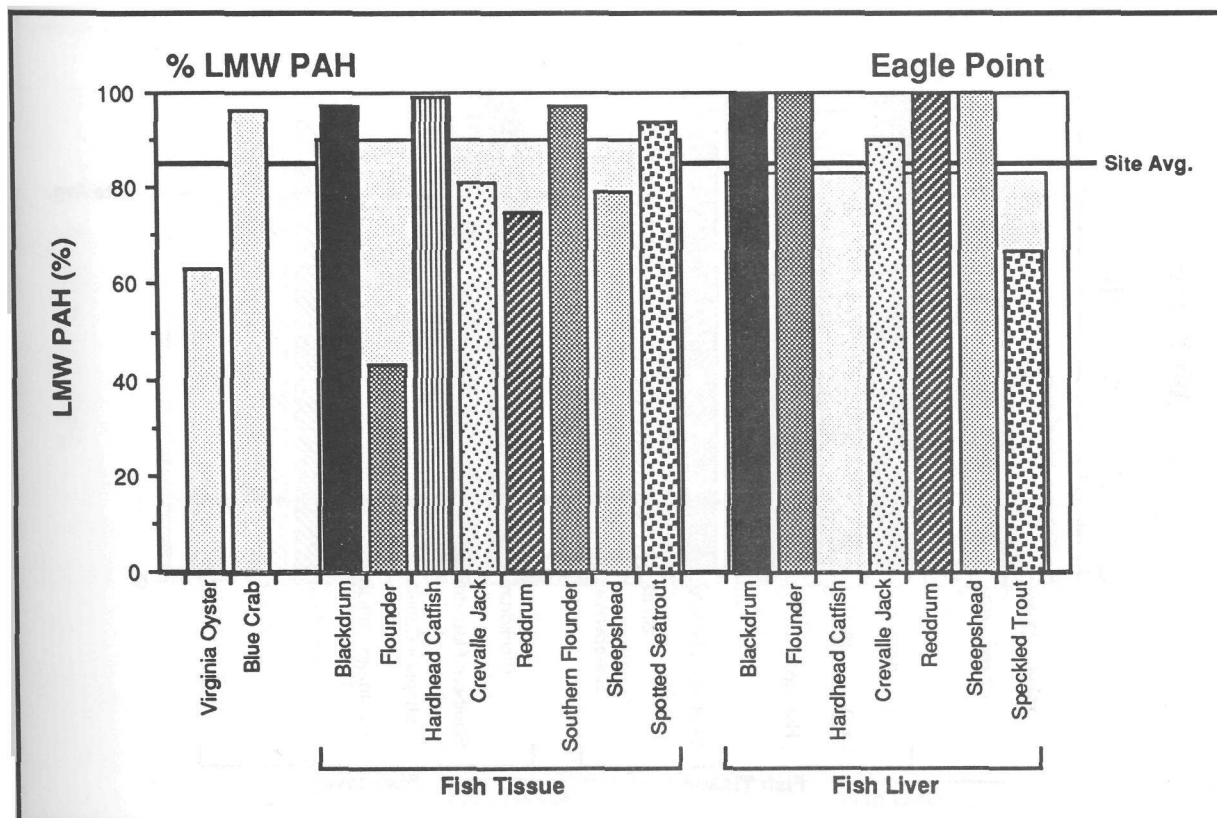
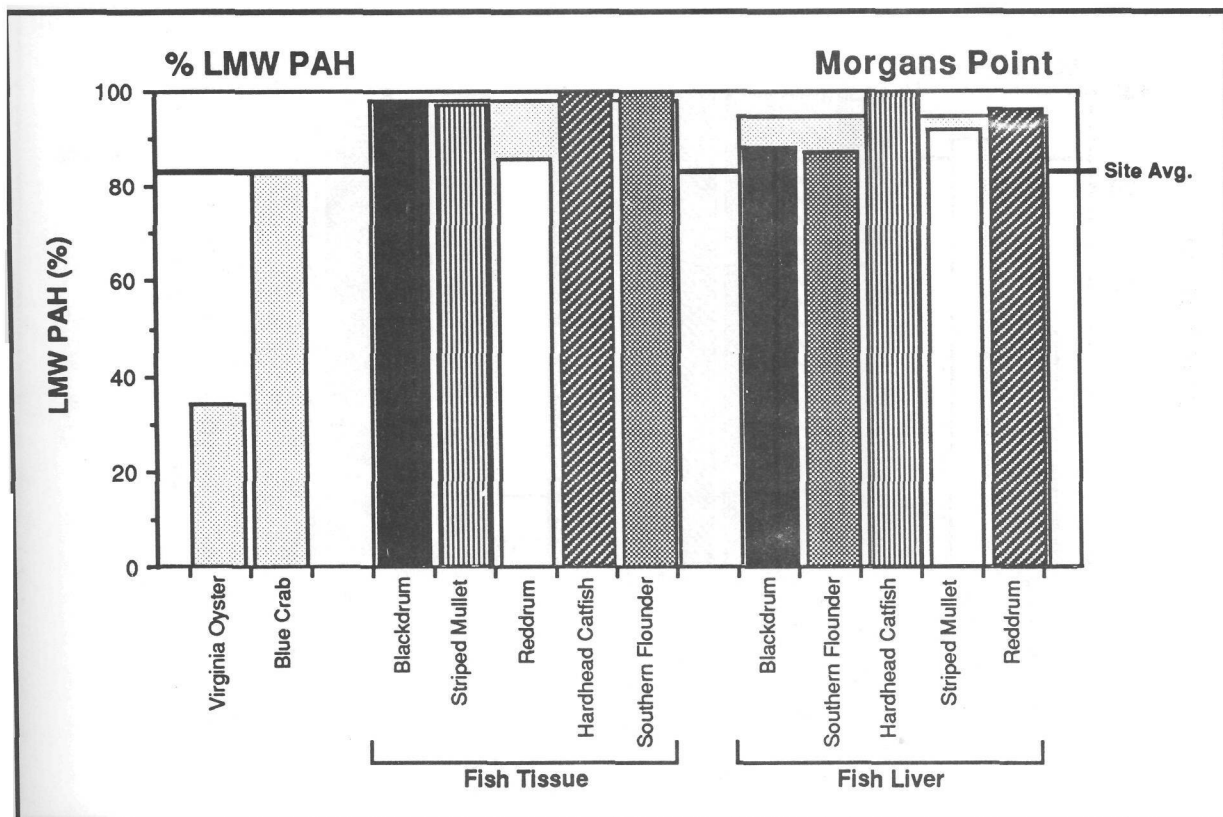


Figure 4.7. Percentage of Low Molecular Weight (LMW) PAH in oysters, crabs, fish tissue, and fish livers from Morgans Point and Eagle Point.

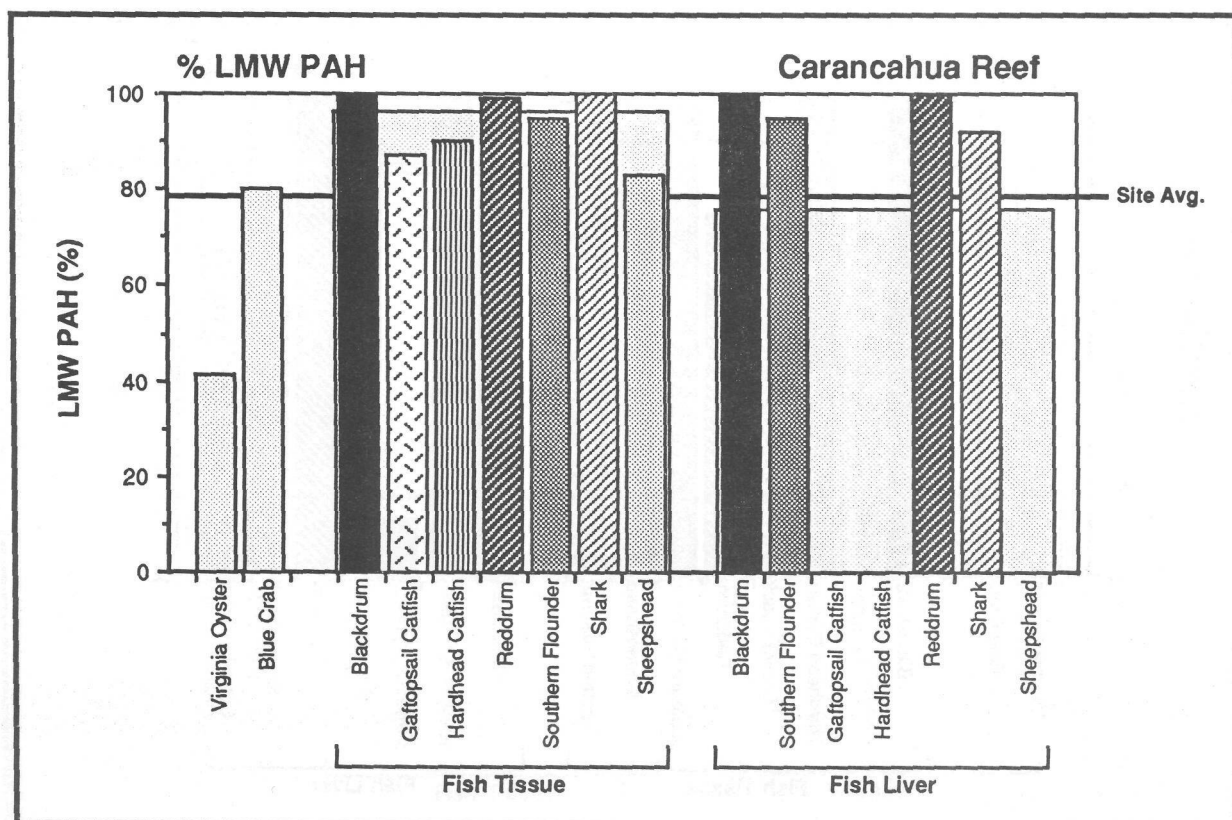
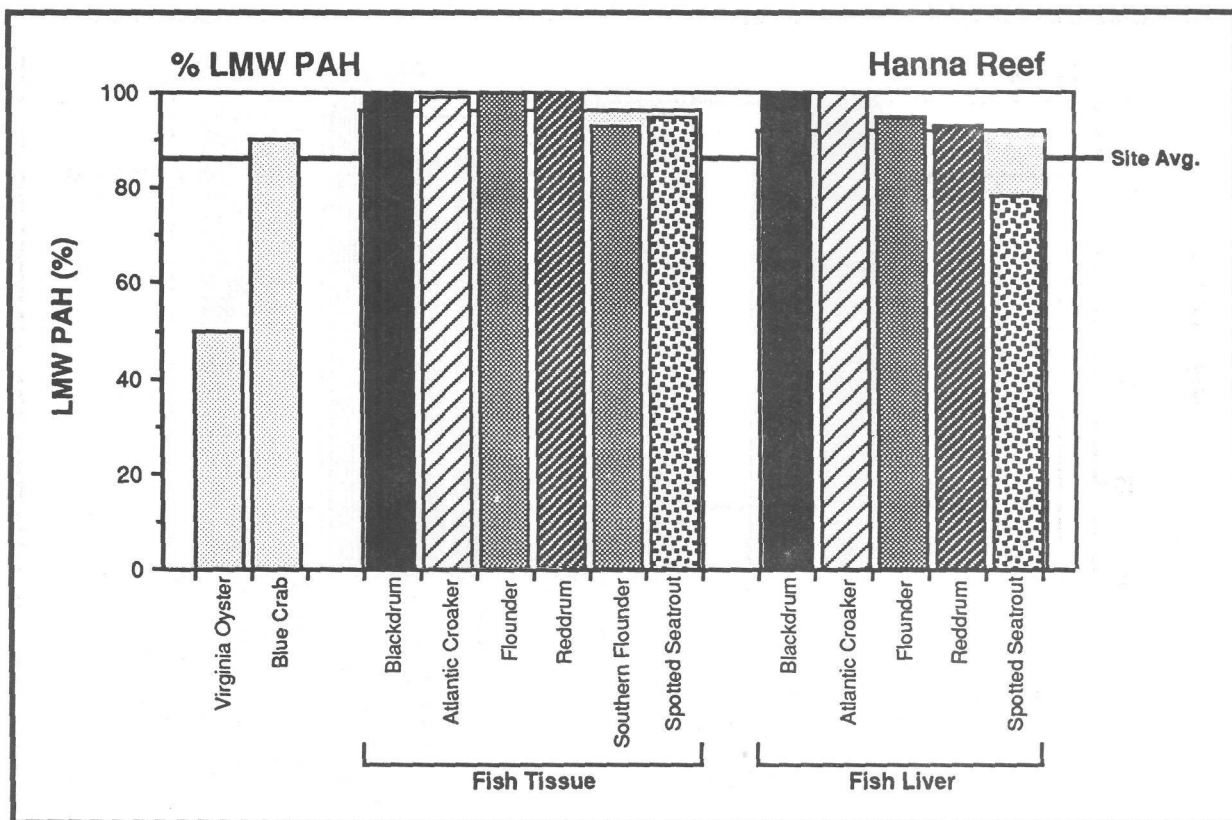


Figure 4.8. Percentage of Low Molecular Weight (LMW) PAH in oysters, crabs, fish tissue, and fish livers from Hanna Reef and Carancahua Reef.

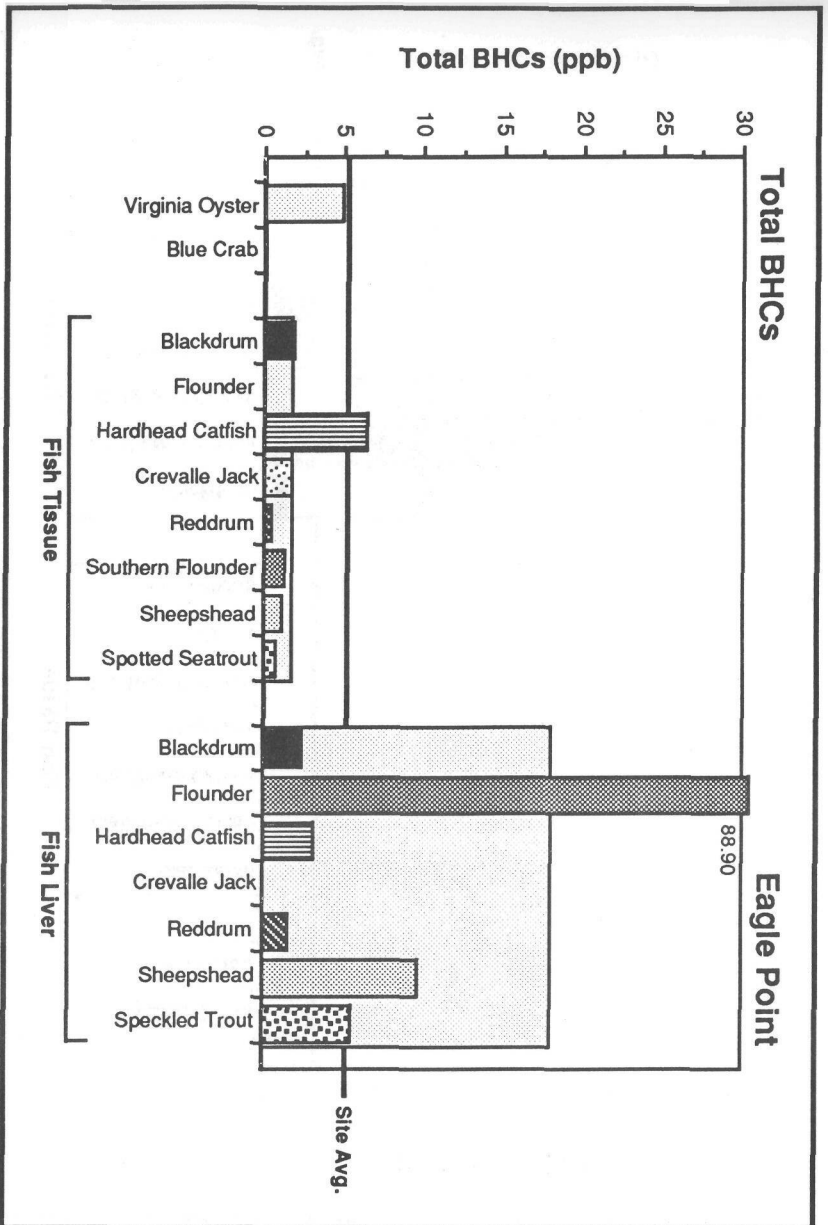
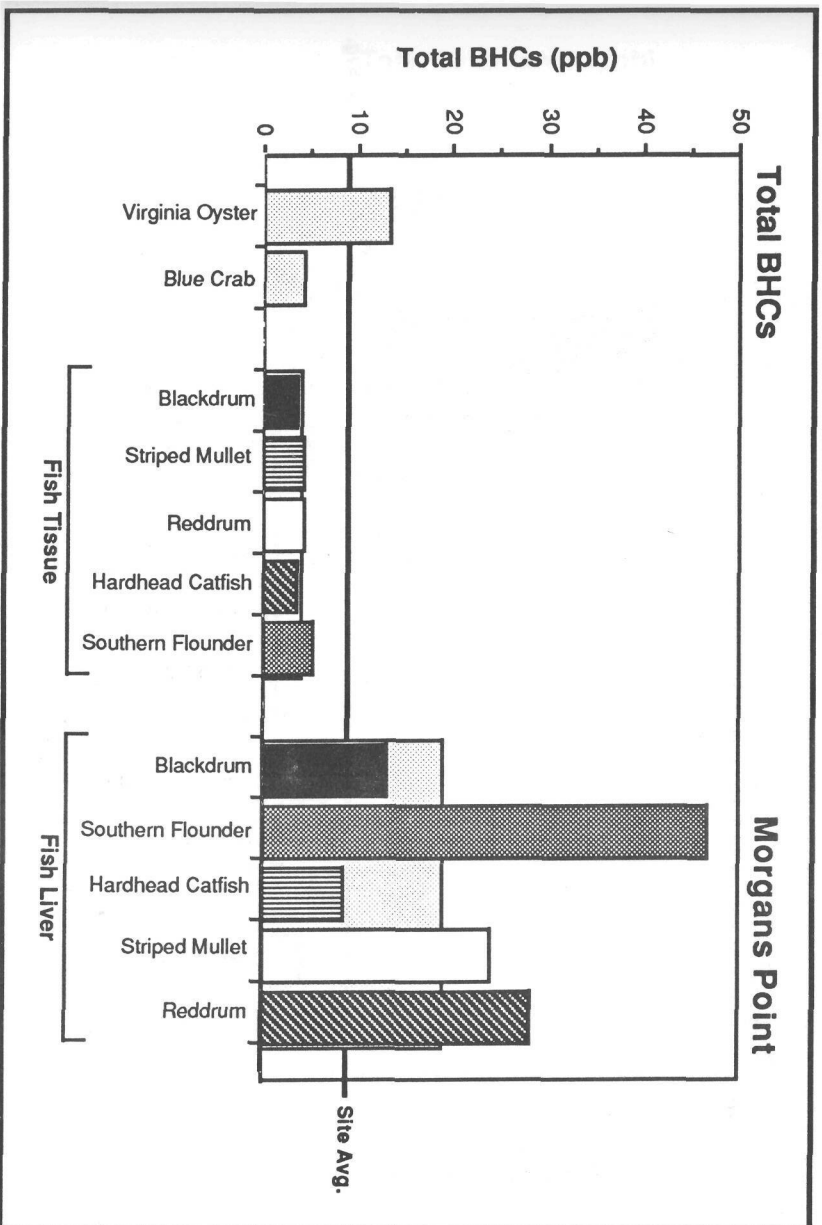


Figure 4.9. Total BHC concentration (ppb) in oysters, crabs, fish tissue, and fish livers from Morgans Point and Eagle Point.

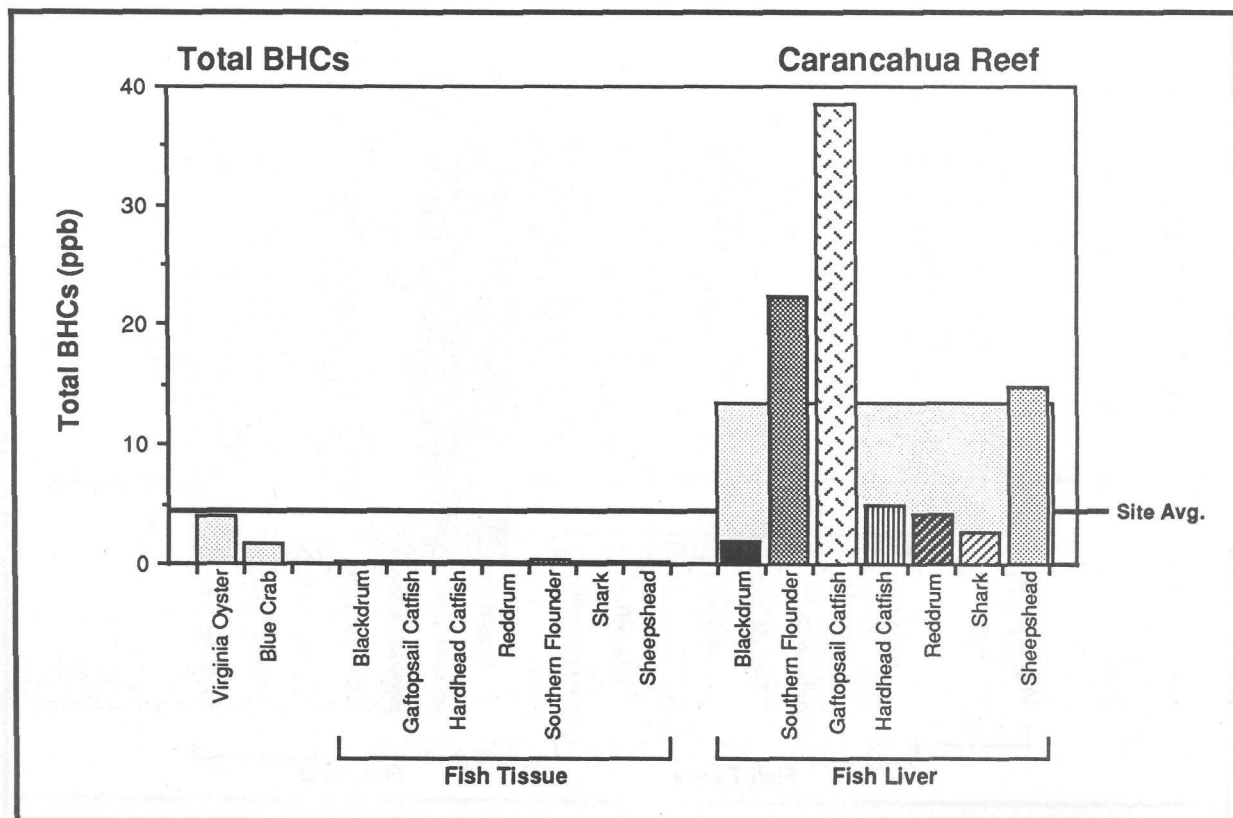
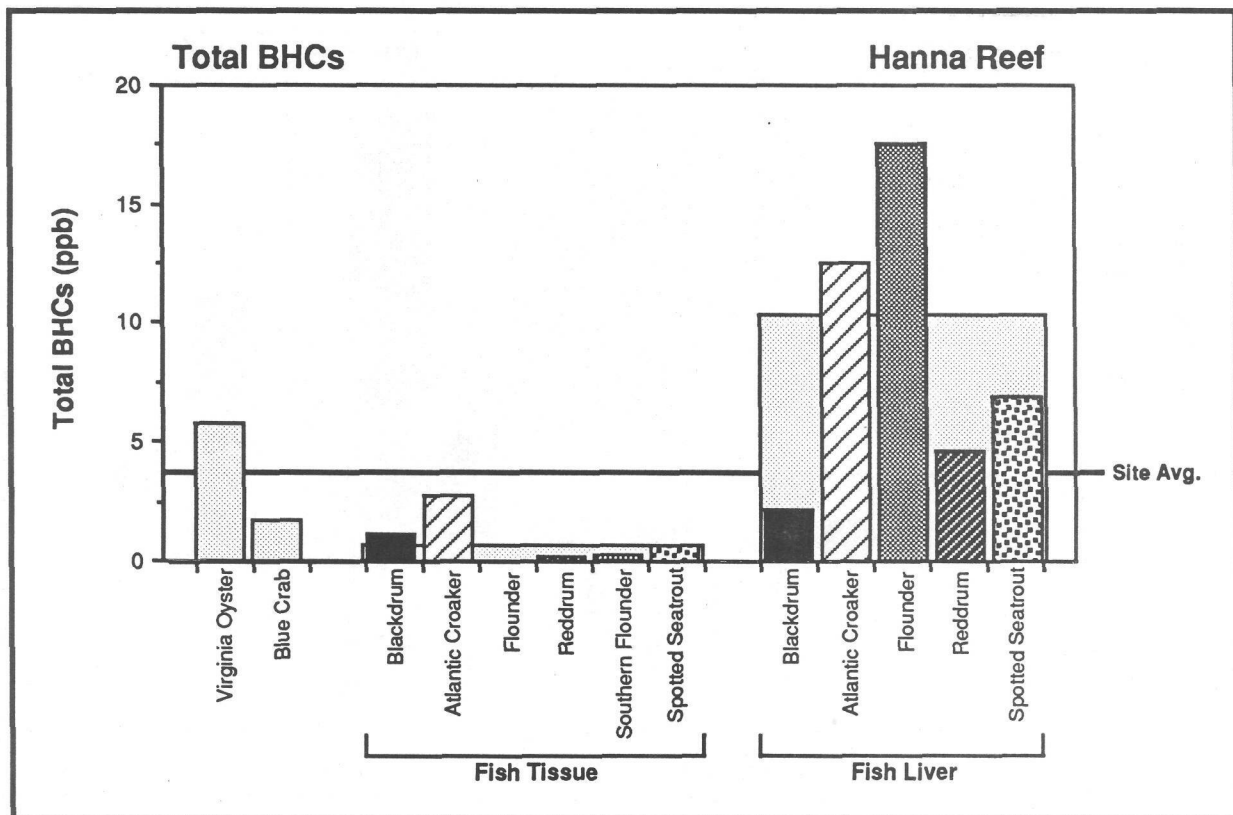


Figure 4.10. Total BHC concentration (ppb) in oysters, crabs, fish tissue, and fish livers from Hanna Reef and Carancahua Reef.

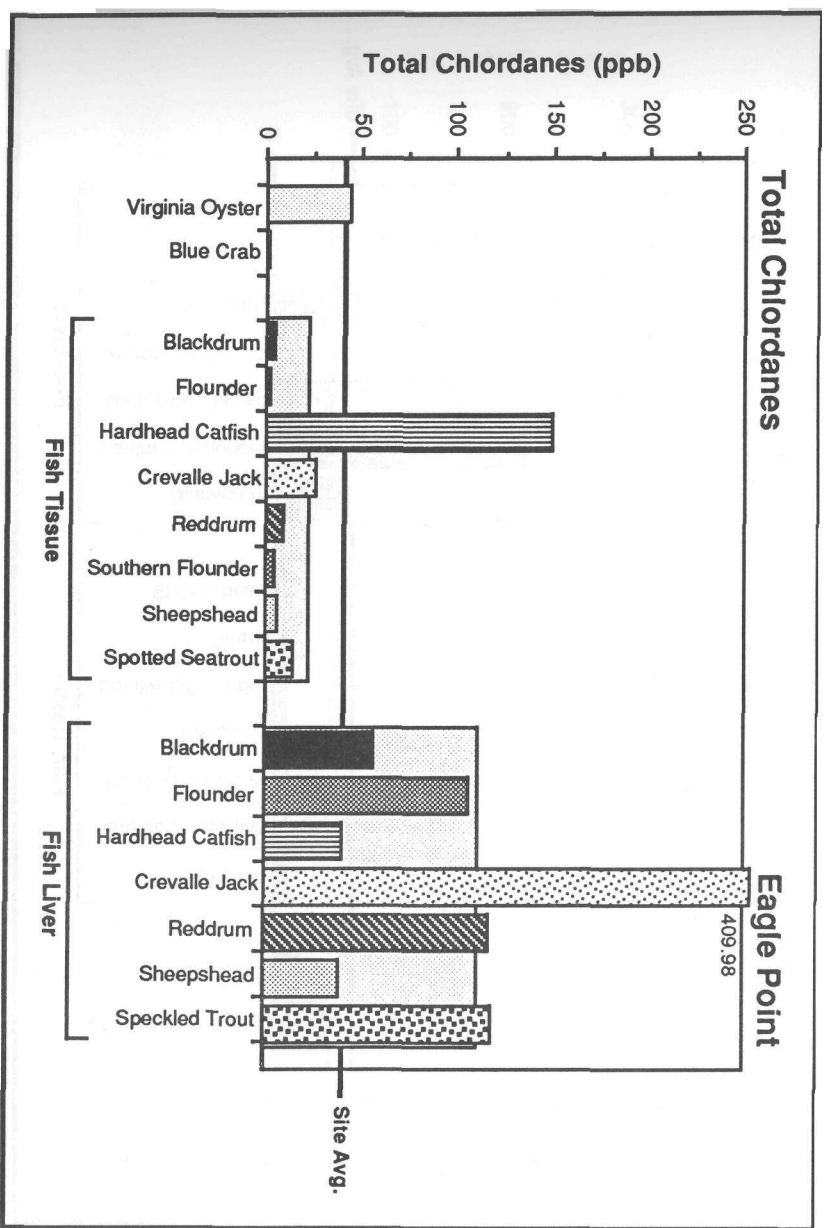
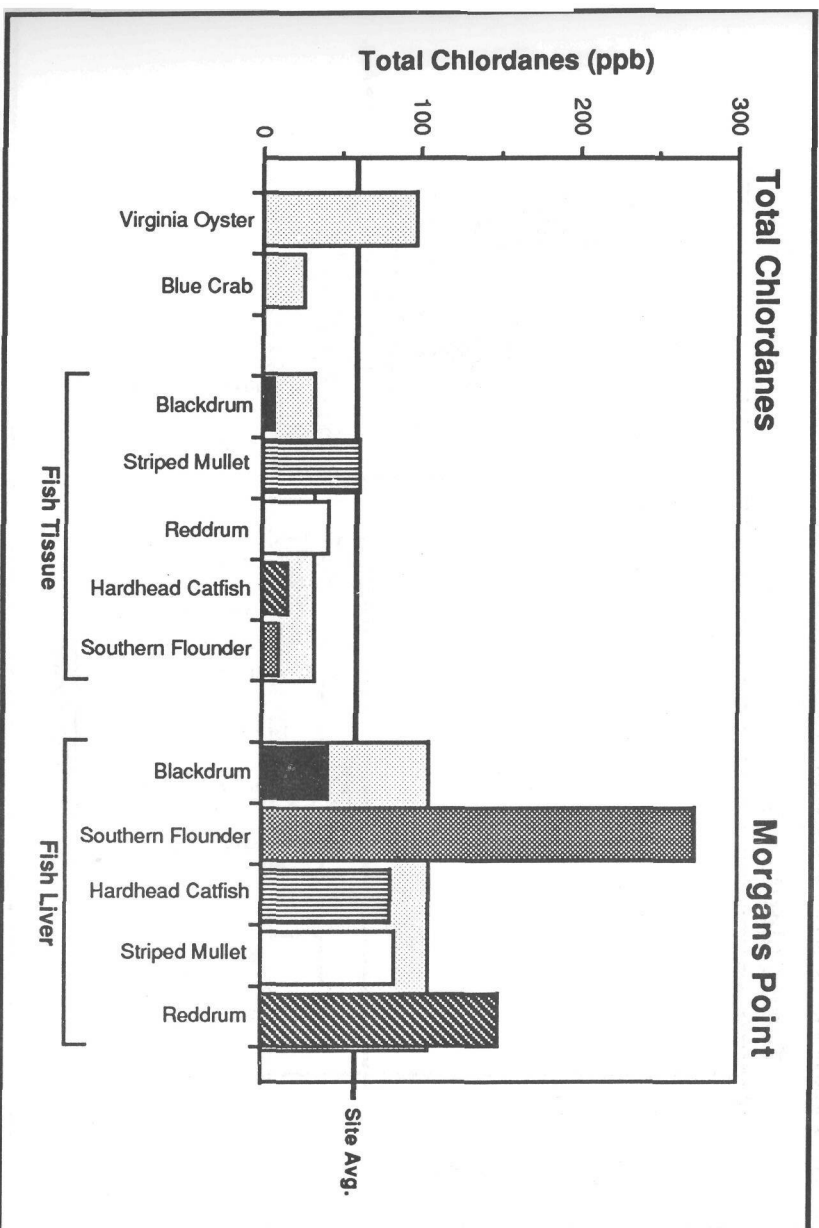


Figure 4.11. Total Chlordane concentration (ppb) in oysters, crabs, fish tissue, and fish livers from Morgans Point and Eagle Point.

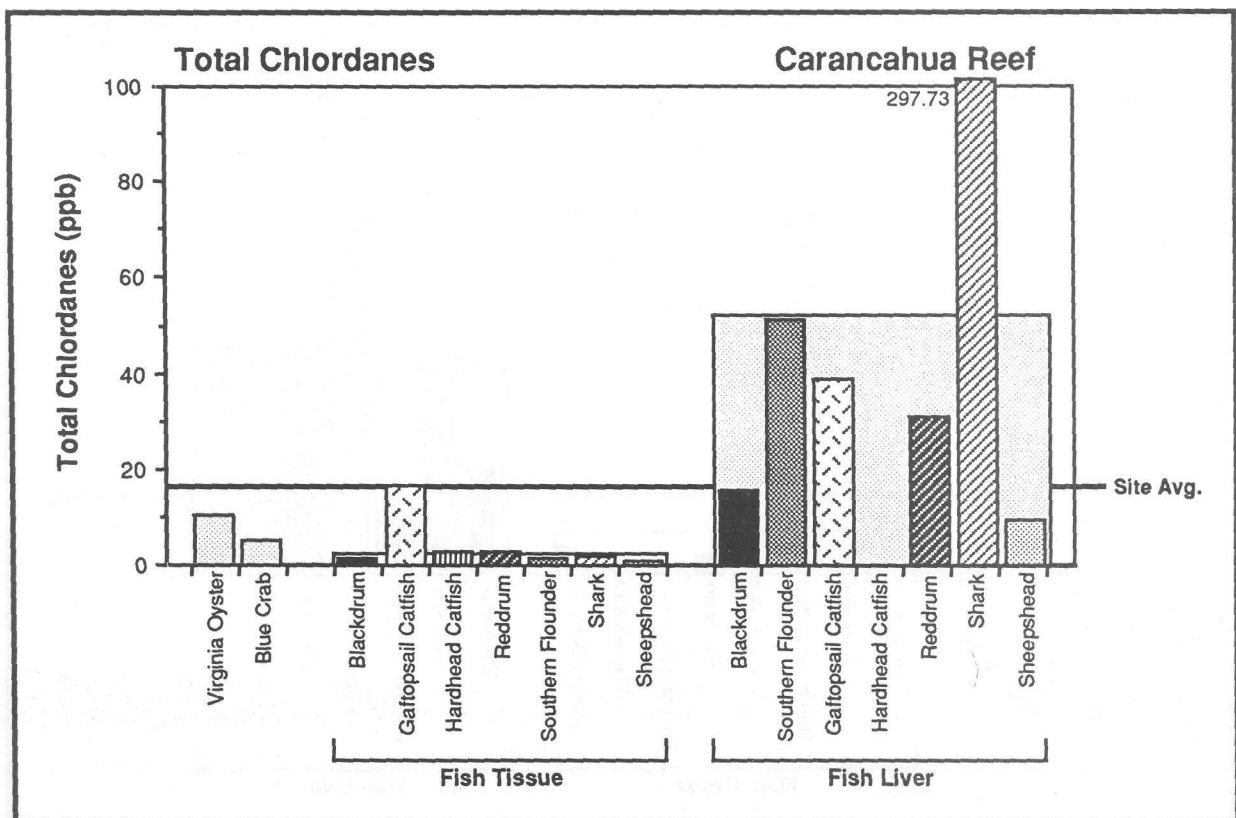
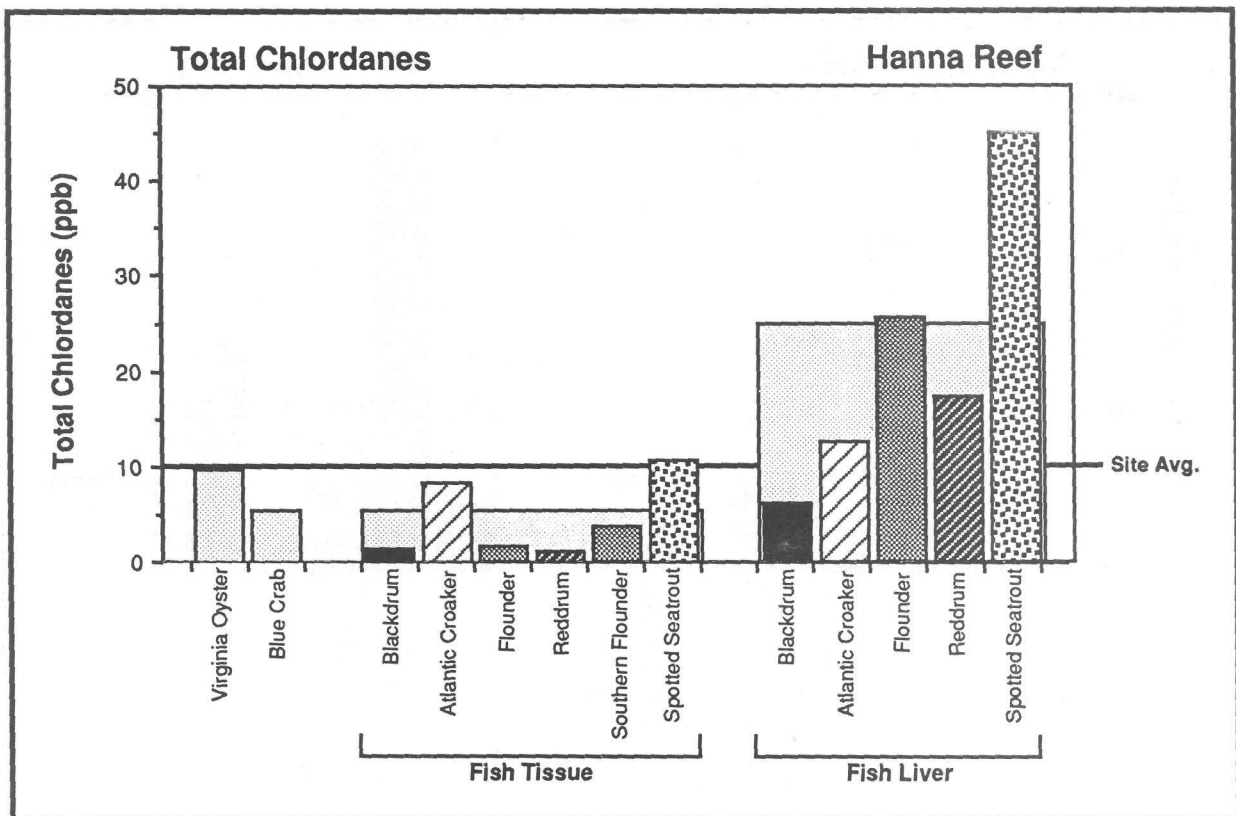


Figure 4.12. Total Chlordane concentration (ppb) in oysters, crabs, fish tissue, and fish livers from Hanna Reef and Carancahua Reef.

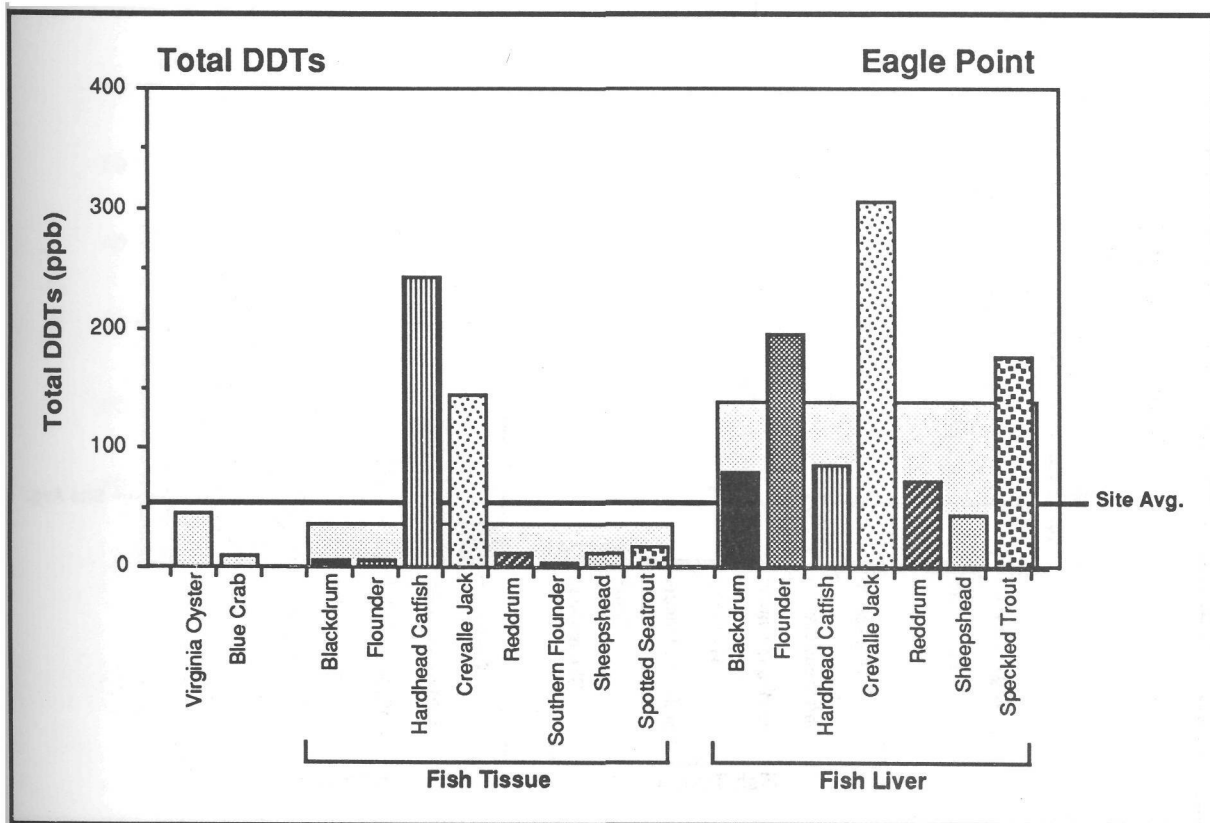
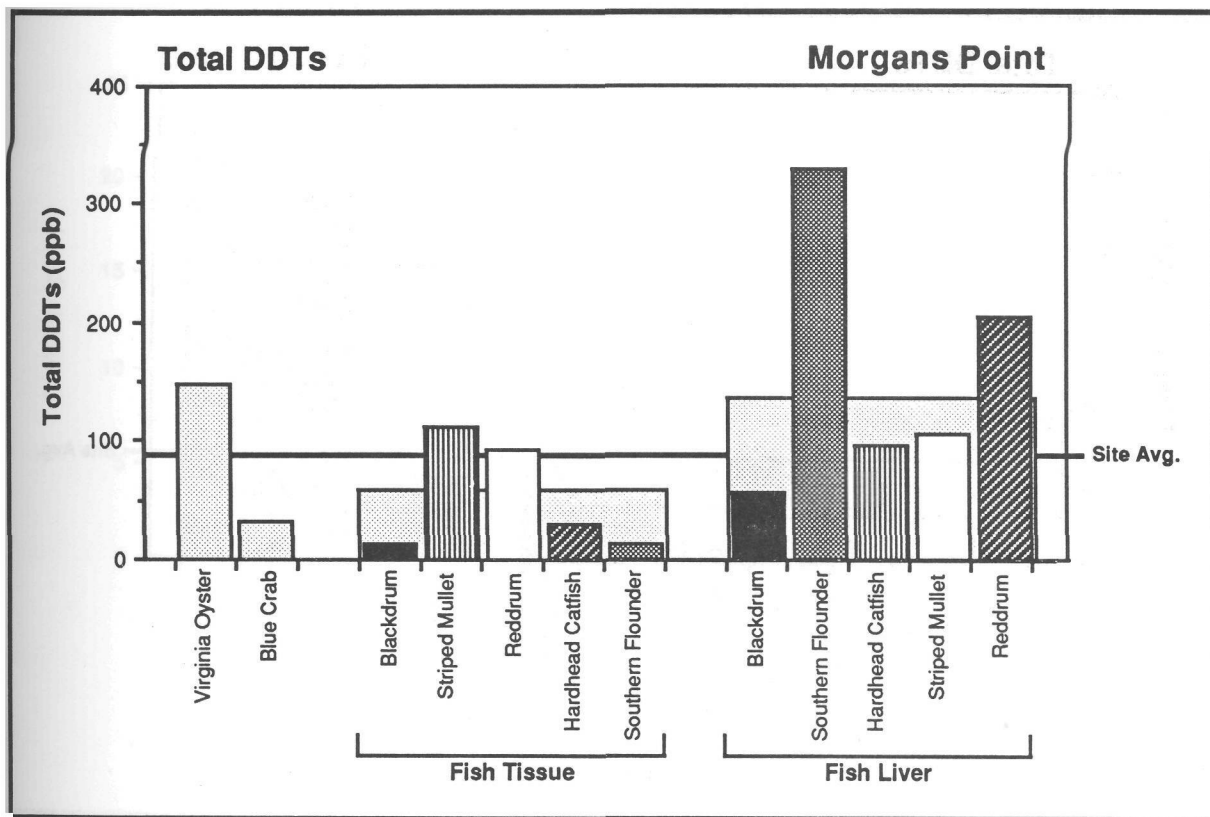


Figure 4.13. Total DDT concentration (ppb) in oysters, crabs, fish tissue, and fish livers from Morgans Point and Eagle Point.

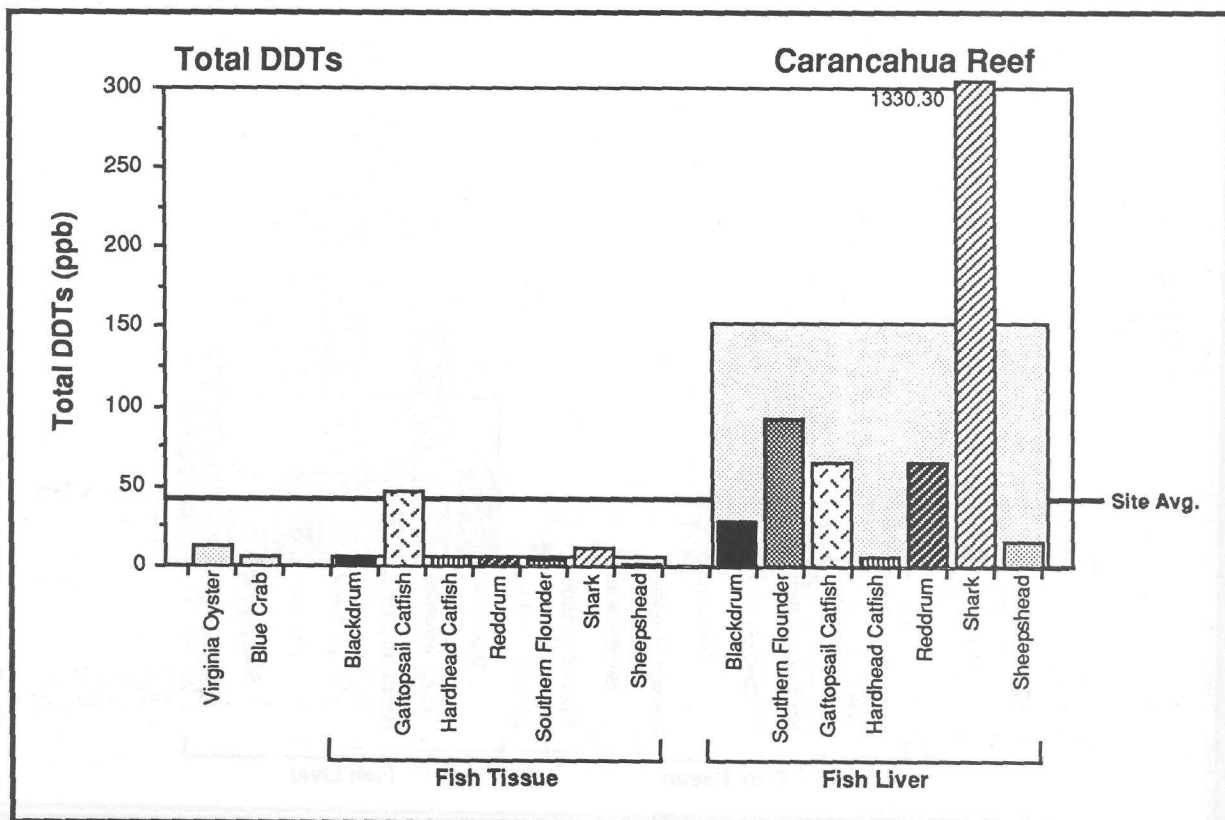
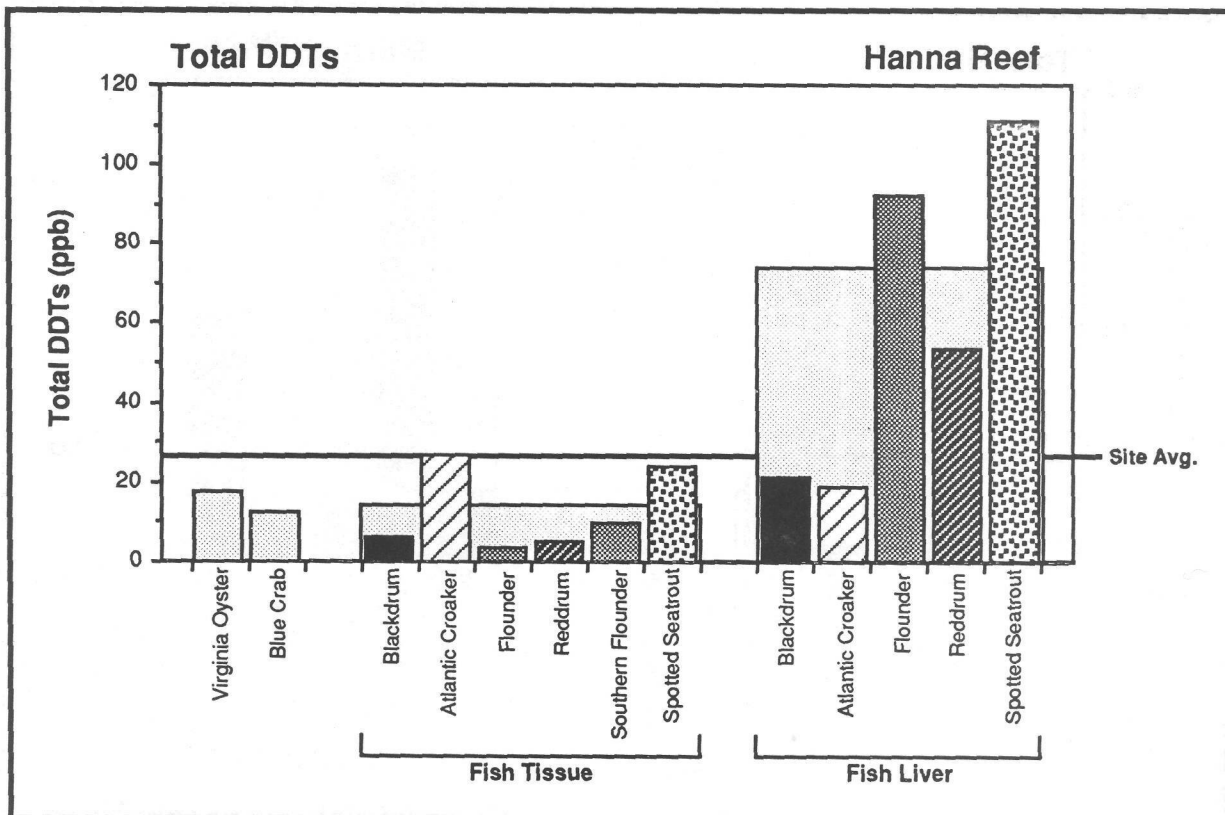


Figure 4.14. Total DDT concentration (ppb) in oysters, crabs, fish tissue, and fish livers from Hanna Reef and Carancahua Reef.

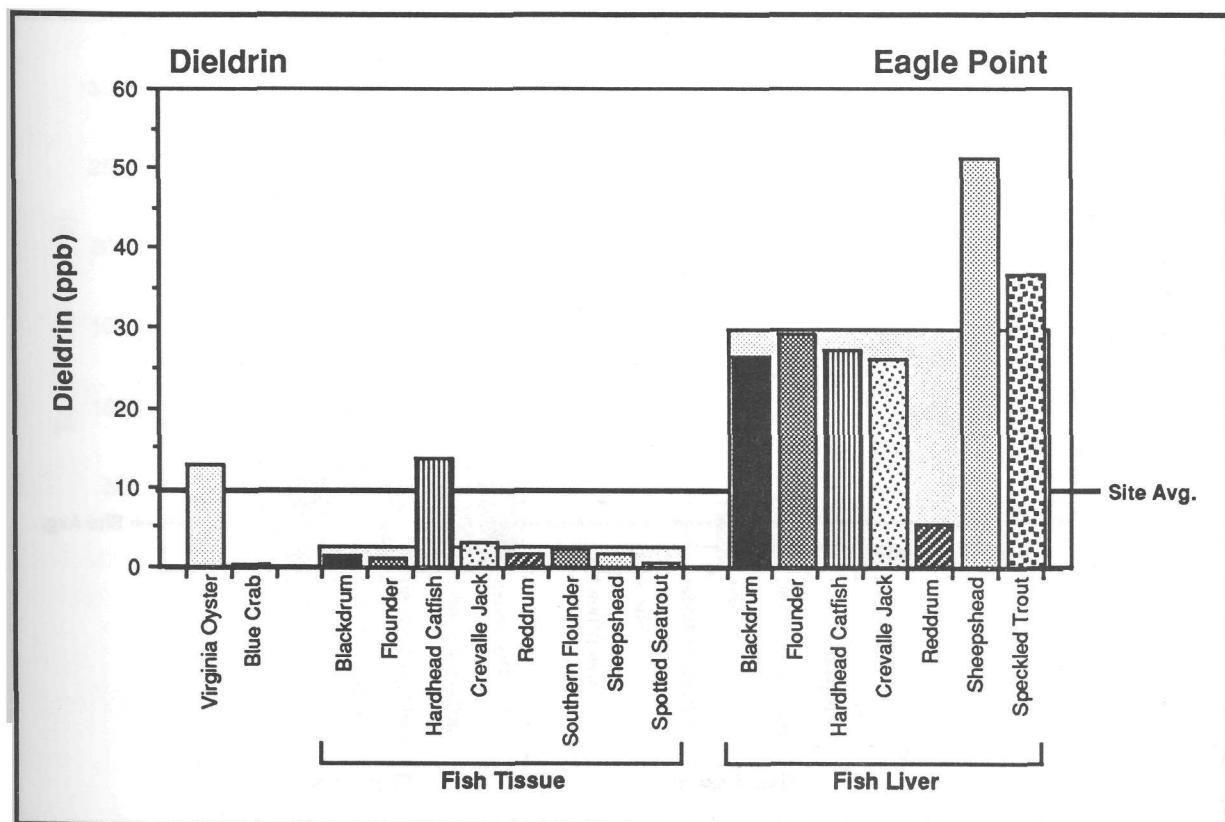
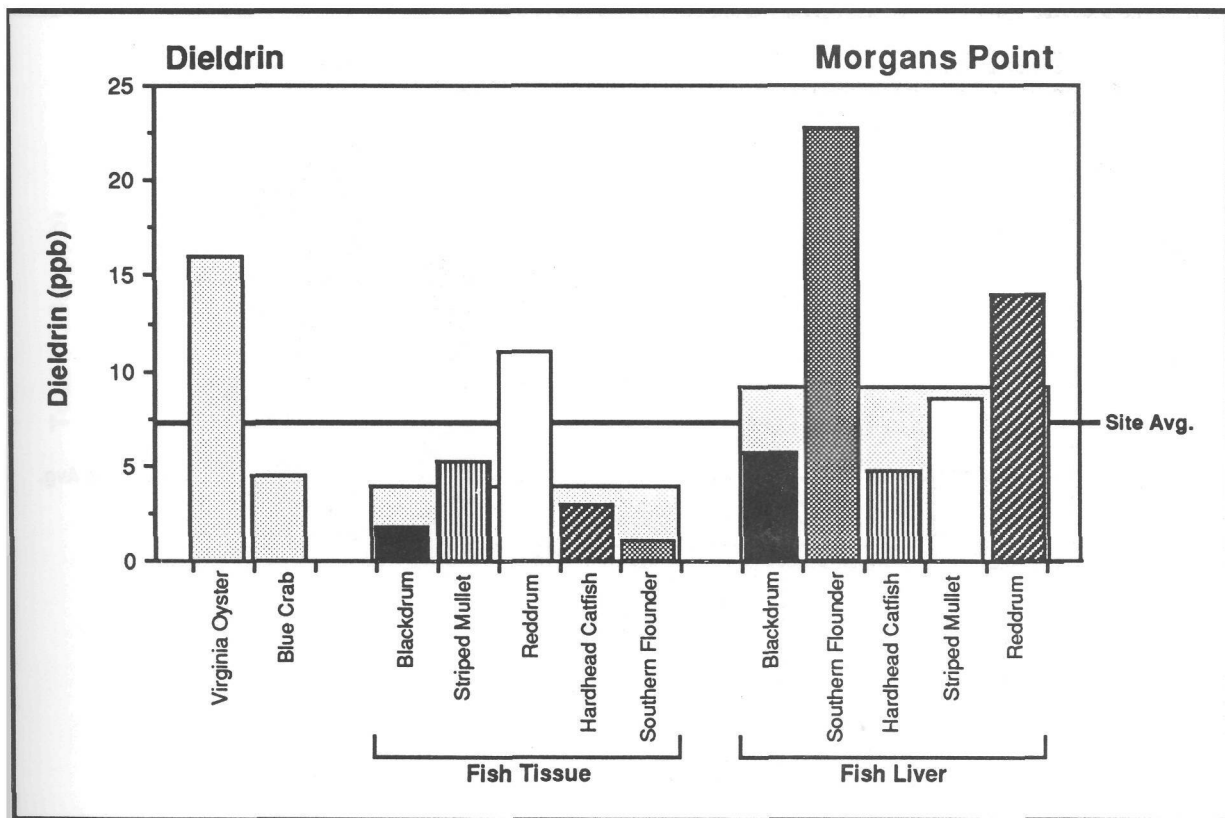


Figure 4.15. Dieldrin concentration (ppb) in oysters, crabs, fish tissue, and fish livers from Morgans Point and Eagle Point.

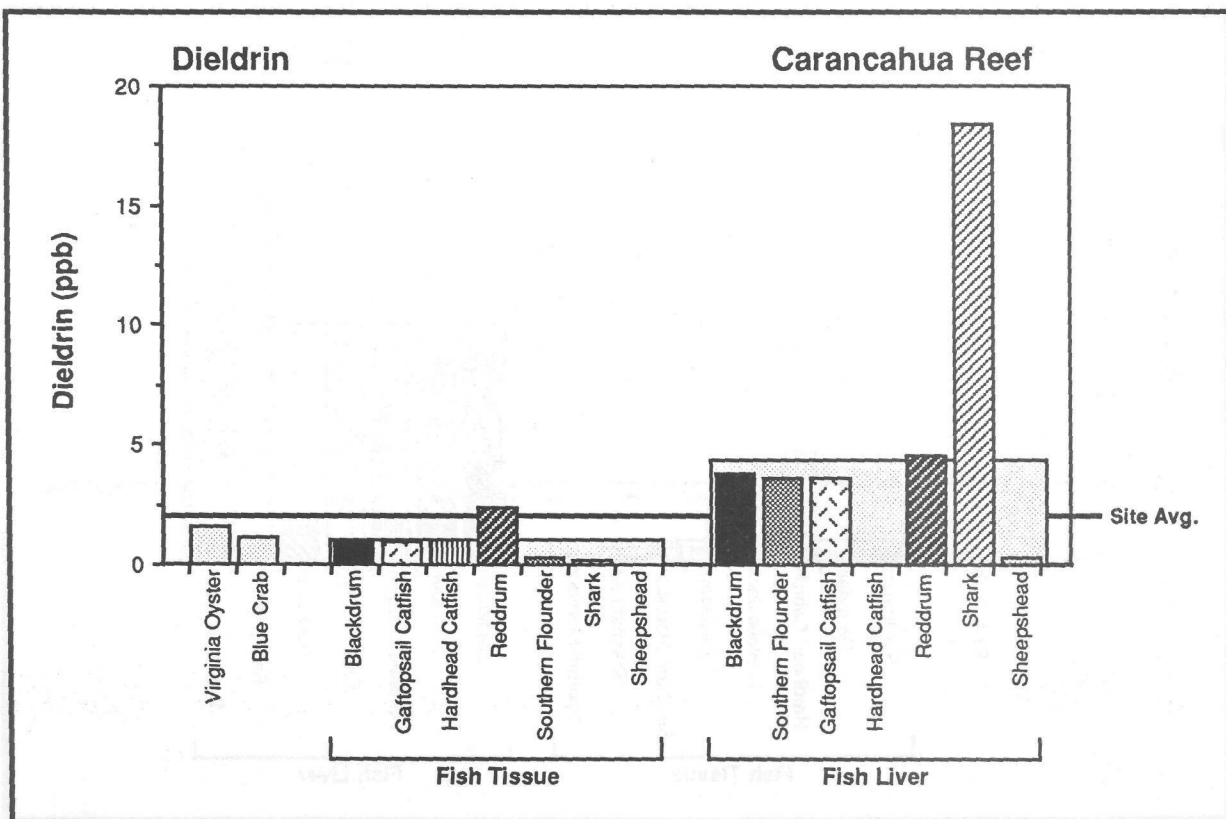
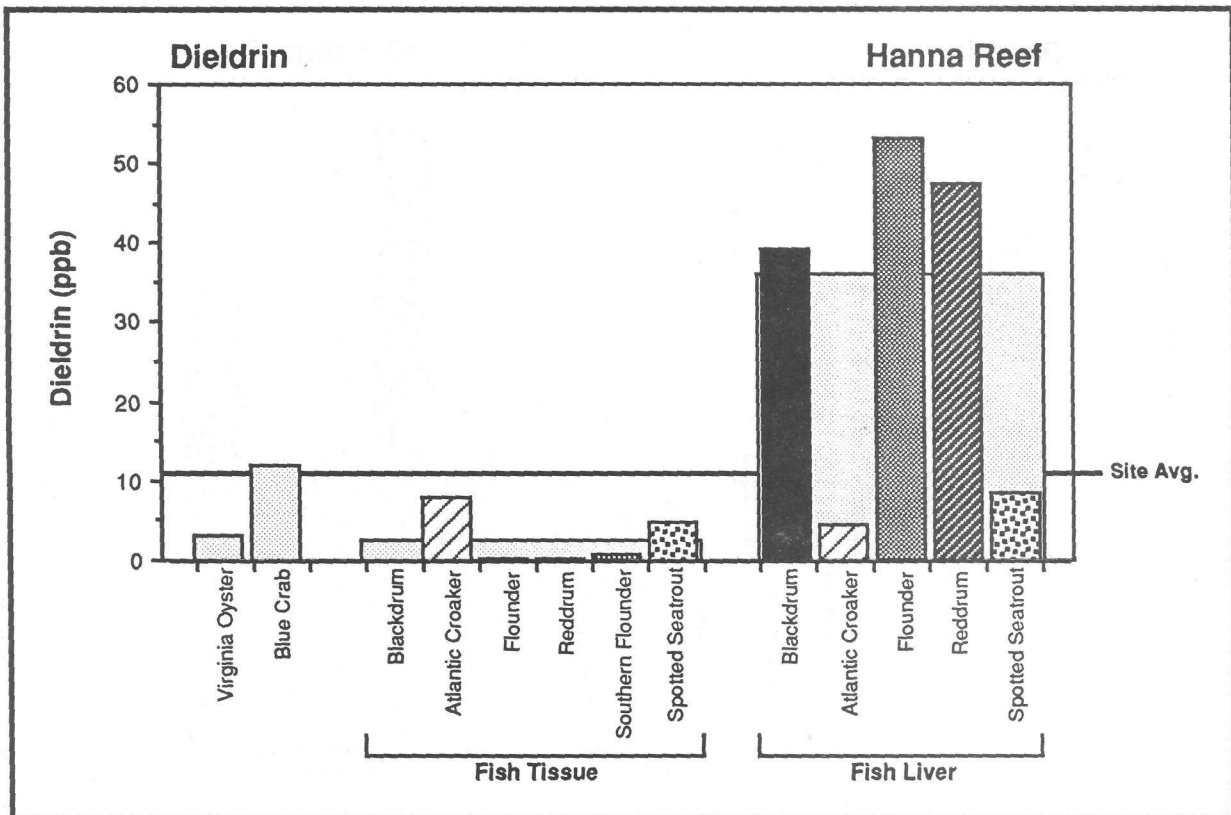


Figure 4.16. Dieldrin concentration (ppb) in oysters, crabs, fish tissue, and fish livers from Hanna Reef and Carancahua Reef.

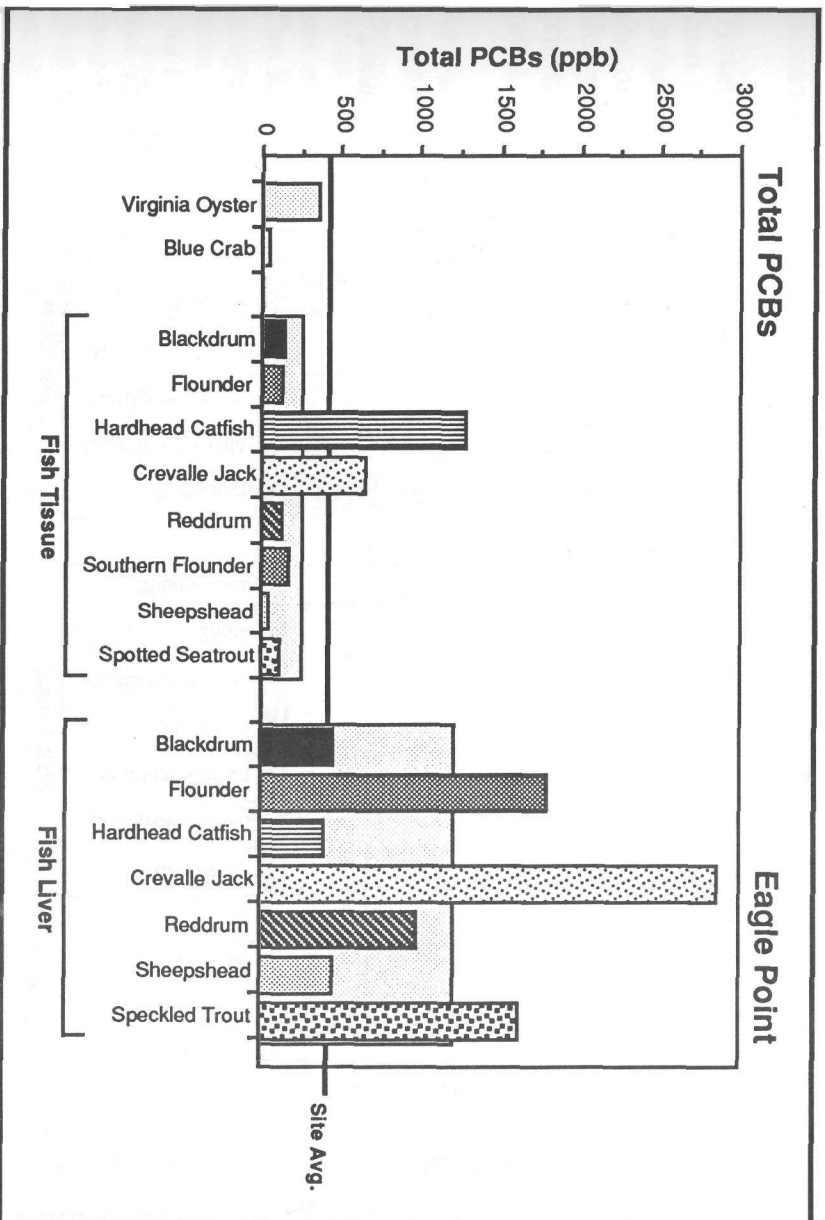
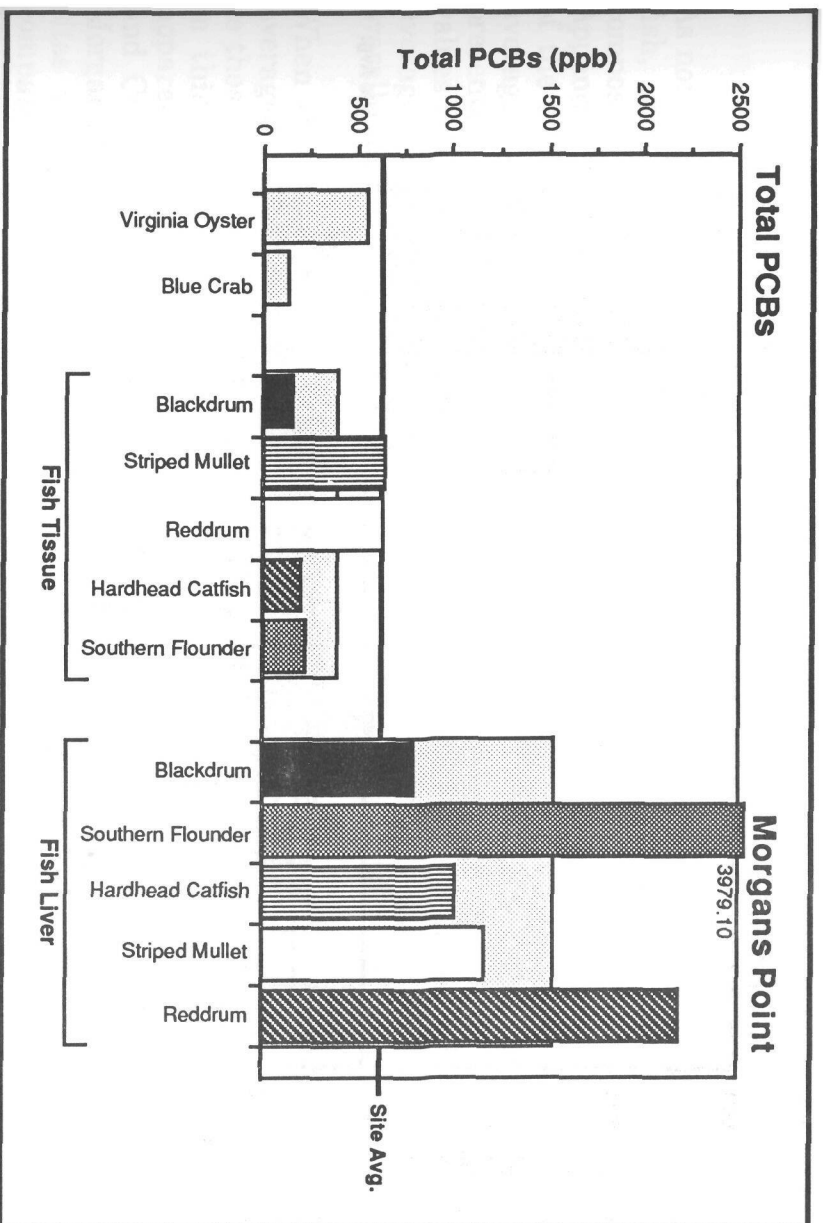


Figure 4.17. Total PCB concentration (ppb) in oysters, crabs, fish tissue, and fish livers from Morgans Point and Eagle Point.

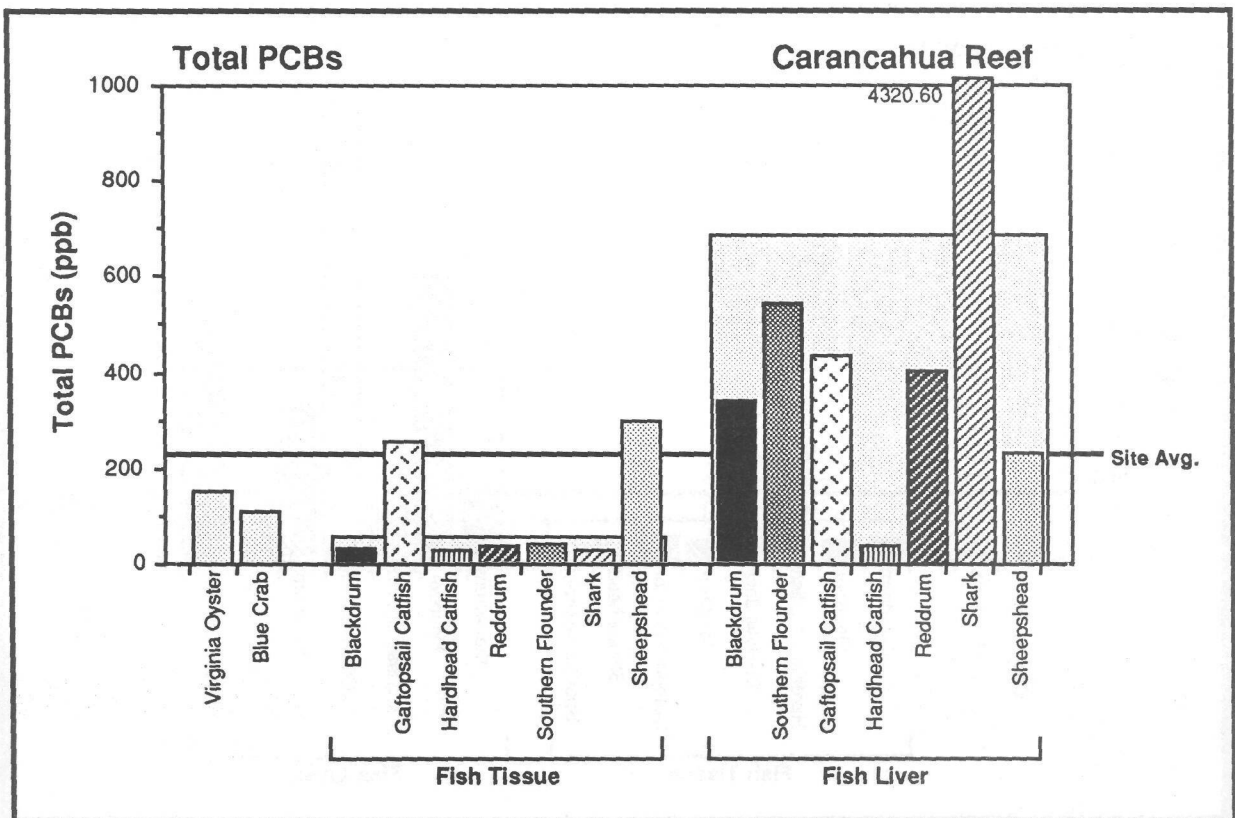
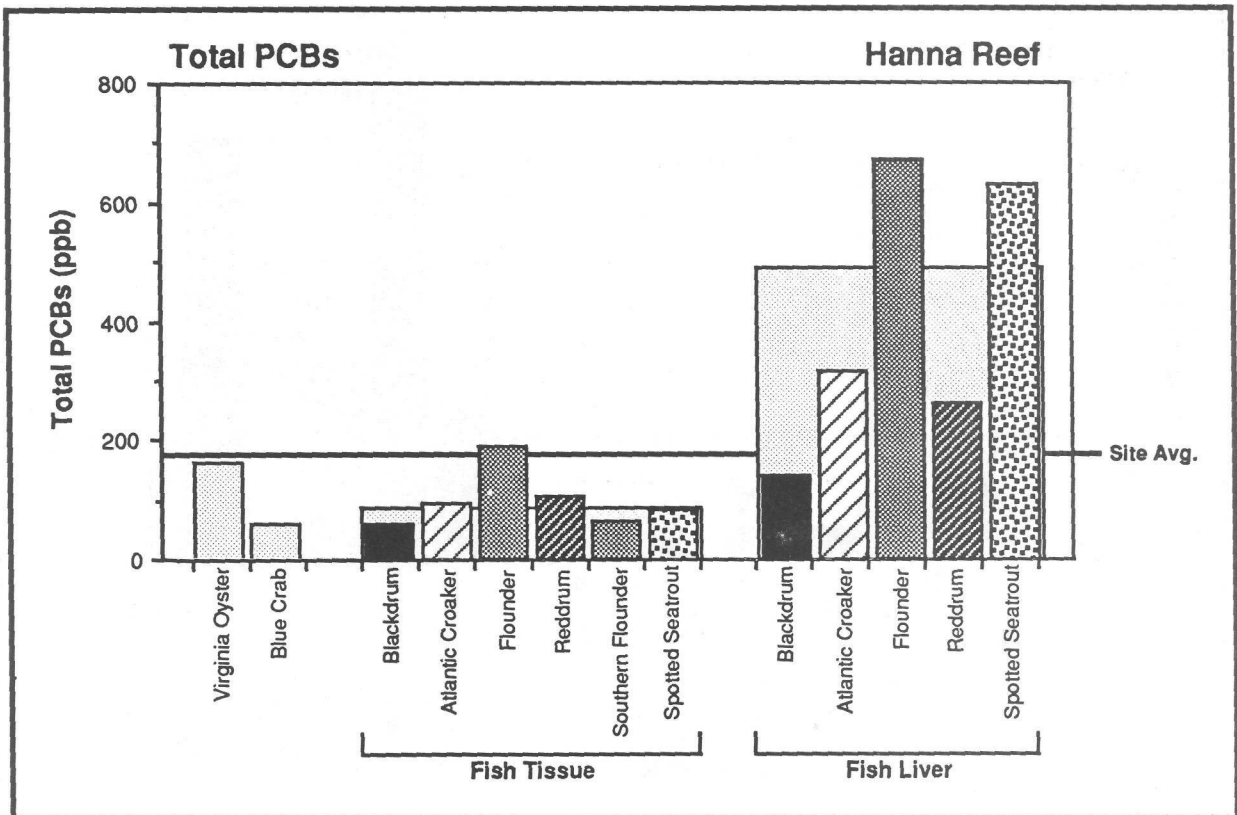


Figure 4.18. Total PCB concentration (ppb) in oysters, crabs, fish tissue, and fish livers from Hanna Reef and Carancahua Reef.